Ornamental Plants

Annual Reports and Research Reviews

2005

January 2006
Special Circular 197
Ohio Agricultural Research and Development Center

In Partnership With Ohio State University Extension
and the OSU Extension Centers at Wooster and Piketon

Steven A. Slack
Director

Ohio Agricultural Research and Development Center
1680 Madison Avenue
Wooster, Ohio 44691-4096
330-263-3700

Cover Photos: The feathery finery of dawnredwood (Metasequoia glyptostroboides) brightens the Ohio Agricultural Research and Development Center's (OARDC) Secrest Arboretum. For more information, see the article on page 166.

Ornamental Plants
Annual Reports and Research Reviews
2005

Edited By

James A. Chatfield
Erik A. Draper
David E. Dyke
Pamela J. Bennett
Joseph F. Boggs

Ohio Agricultural Research and Development Center
Ohio State University Extension
Department of Horticulture and Crop Science
The Ohio State University

January 2006
Special Circular 197
Ohio Agricultural Research and Development Center

In Partnership With Ohio State University Extension
and the OSU Extension Centers at Wooster and Piketon

Acknowledgments

Editing
Joy Ann Fischer, Communications and Technology

Cover Design
Mary Hoffelt, Communications and Technology

Cover Photos
Ken Chamberlain, Communications and Technology

Salaries and research support were provided by state and federal funds appropriated to the Ohio Agricultural Research and Development Center and Ohio State University Extension of The Ohio State University's College of Food, Agricultural, and Environmental Sciences. Additional grant support was provided by the organizations and companies listed in the individual research and Extension reports.

Contents

Ohio State University Extension Nursery, Landscape, and Turf Team Directory: 2006

Our Vision

The vision of the Extension Nursery, Landscape, and Turf Team (ENLTT) is to serve as the University's partner with the green industry to position us for the future.

Our Mission

The mission of the Extension Nursery, Landscape, and Turf Team, through our interdisciplinary and industry partnerships, is to improve the process of acquisition, delivery, and support of accurate, practical, and timely educational resources.

An Invitation

Membership on the team is based on interest and commitment to the vision and the mission of the team. Potential members are encouraged to participate in some of our activities to determine if they would like to become a part of our team. If you are interested in the work of the team, please contact any of the team members.

Key ENLTT Activities

The OSU Extension Nursery Landscape and Turf Team expresses great appreciation for the generous funding support from the Ohio Nursery and Landscape Association (ONLA) and the continuing support of Ohio State University Extension and the OSU College of Food, Agricultural, and Environmental Sciences.

Some of our key activities and projects as a team are listed on the following page.

Directory developed by Jack Kerrigan, Ohio State University Extension, Cuyahoga County.

Key ENLTT Activities

- OSU Nursery Short Course
- Buckeye Yard and Garden Line
- Pictures/Descriptions for ONLA Landscape Plants and Perennial Plants booklets
- OSU Ornamental Plants Special Circular
- Text for ONLA's Ohio Certified Nursery Technician Manuals and Tests
- Develop ONLA's Green Industry Economic Survey
- ONLA/OSU BackPocket Gardener
- Plant Evaluation Trials Throughout Ohio
- Pesticide Applicator Training Programs in Ornamentals and Turf
- Farm Science Review Utzinger Garden
- Buckeye articles and many other publications by ENLTT authors
- Latino Worker publications, tours, web site, and article translations
- OSU/ONLA Research Day
- Lake County Nursery IPM Program
- Invasive Species Workshops for industry, educators, and the public
- Special Schools: Tri-State Green Industry Expo, Secrest Academy of Landscape Sciences and Arts, Plant Health Care, and Diagnostic Workshops
- Next STEP [Street Tree] program

Team Members

Betsy Anderson

- Ornamental plant pesticide research (IR-4 Program)
- Biological pest control
- Identification of nursery, greenhouse, and landscape pesticide needs
- Registration of new pesticide products

Biological Science Technician, USDA, Agricultural Research Service
IR-4 Ornamentals Project
Horticultural Insects Laboratory, Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691
330-263-3898
330-263-3969 Fax
anderson.523@osu.edu

Charles Behnke

- Diagnosis of cultural problems of trees and shrubs
- Weed identification
- Insect identification
- Greenhouse management
- Garden center employee training
- IPM

Extension Educator, Horticulture, Lorain County
Ohio State University Extension
42110 Russia Road
Elyria, OH 44035-6815
440-322-0127
440-329-5351 Fax
behnke.1@osu.edu

Pam Bennett

- Consumer and environmental horticulture
- Garden center management
- Landscape ornamentals
- Landscape maintenance
- Communications
- Master Gardener Program

Extension Educator and County Director, Horticulture, Clark County
Ohio State University Extension
4400 Gateway Blvd., Suite 104
Springfield, OH 45502-9337
937-328-4607
937-328-4609 Fax
bennett.27@osu.edu

Barbara Bloetscher
- Insect and arthropod identification
- Diagnosis of plant symptoms and insect injuries
- Diagnosis of structures and materials damaged by insects

Entomology Diagnostician
C. Wayne Ellett Plant and Pest Diagnostic Clinic
The Ohio State University
110 Kottman Hall
2021 Coffey Road
Columbus, OH 43210
614-292-5902
614-292-4455 Fax
bloetscher.1@osu.edu

Joe Boggs
- Ornamental entomology
- Landscape management
- Turf management
- Tree nursery management
- Urban forestry
- Diagnosis of plant problems
- IPM
- Christmas tree production

Extension Educator, Horticulture, Hamilton County
Extension Specialist, Horticulture, Ohio State University Extension Center at Piketon
110 Boggs Lane, Suite 315
Cincinnati, OH 45246-3145
513-946-8993
513-528-0034 Fax
boggs.47@osu.edu

Pierluigi (Enrico) Bonello
- Fungal tree pathology
- Molecular ecology of ectomycorrhizal fungi
- Ecology of multi-party systems

Associate Professor, Plant Pathology
The Ohio State University
483C Kottman Hall
2021 Coffey Road
Columbus, OH 43210-1087
614-292-1375
614-292-4455 Fax
bonello.2@osu.edu

Ken Chamberlain
- Photography

Publications Photographer
Communications and Technology
The Ohio State University
Ohio Agricultural Research and Development Center
231 Research Services Building
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3779
330-202-3504 Fax
chamberlain.1@osu.edu

Jim Chatfield
- Diagnosis of plant problems
- Plant disease control
- Ornamental plant selection
- Plant pest monitoring
- IPM

Assistant State Specialist, Landscape Horticulture, Department of Horticulture and Crop Science
Extension Specialist, Ohio State University Extension Center at Wooster
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3799
330-263-3667 Fax
chatfield.1@osu.edu

Joe Cochran
- Ornamental and consumer horticulture
- Marketing
- Business management
- Master Gardener Program
- Gardening with Youth

Program Coordinator, Secrest Arboretum
The Ohio State University
Ohio Agricultural Research and Development Center
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3886
330-263-3713 Fax
cochran.58@osu.edu

Ken Cochran
- Taxonomy and classification of ornamental plants
- Plant selection for environmental enhancement
- Landscape management
- Nursery operations and management
- Plant propagation

Curator, Secrest Arboretum
The Ohio State University
Ohio Agricultural Research and Development Center
Ohio State University Extension
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3761
330-263-3713 Fax
cochran.7@osu.edu

Annette Deutz
- Ornamental horticulture

Director, Horticulture and Crop Science Learning Garden
Department of Horticulture and Crop Science
The Ohio State University
232D Howlett Hall
2001 Fyffe Court
Columbus, OH 43210
614-247-5000
614-292-3505 Fax
duetz.1@osu.edu

Erik Draper
- Plant, pest, and site diagnosis
- IPM
- Landscape installation and management
- Tree fruits and small fruit management

Extension Educator and County Director, Horticulture, Geauga County
Ohio State University Extension
P. O. Box 387, 14269 Claridon-Troy Road
Burton, OH 44021-0387
440-834-4656
440-834-0057 Fax
draper.15@osu.edu

Dave Dyke
- Floriculture
- Greenhouse management
- Marketing
- Greenhouse/Garden Center employee training
- Master Gardener program

Extension Educator, Commercial Floriculture
Ohio State University Extension
110 Boggs Lane, Suite 315
Cincinnati, OH 45246-3145
513-946-8983
513-528-0034 Fax
dyke.15@osu.edu

Denise Ellsworth
- Pest diagnosis
- IPM in the landscape
- Master Gardener Program
- Youth gardening, garden design, and teacher training

Extension Educator, Horticulture and Environmental Education
Ohio State University Extension, Summit County
2525 State Road
Cuyahoga Falls, OH 44223-1602
330-928-4769
330-928-9418 Fax
ellsworth.2@osu.edu

Gary Gao
- Tree fruits and small fruits
- Plant and soil nutrition
- Consumer horticulture
- Garden center employee training
- Plant physiology

Extension Educator and County Director, Horticulture, Clermont County
Ohio State University Extension
P. O. Box 670, 1000 Locust Street
Owensville, OH 45160-0670
513-732-7070
513-732-7060 Fax
gao.2@osu.edu

David Goerig
- Landscape conservation (parks and recreation)
- Commercial landscape management
- IPM

Extension Educator and County Director,
Agriculture and Natural Resources,
Mahoning County
Ohio State University Extension
490 South Broad Street
Canfield, OH 44406-1604
330-533-5538
330-533-2424 Fax
goerig.1@osu.edu

Dan Herms
- Integrated pest management for nurseries, landscapes, and urban forests
- Pest monitoring tools, including degree-days and phenology
- Ecological interactions between plants and insects
- Emerald ash borer and gypsy moth management

Associate Professor, Entomology
Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691
330-202-3506
330-263-3686 Fax
herms.2@osu.edu

Susan Jones
- Termite control
- Household pests
- Inspecting structures for wood-destroying organisms

State Specialist, Household and Structural Pests
Department of Entomology
The Ohio State University
Extension Entomology Building
1991 Kenny Road
Columbus, OH 43210-1000
614-292-2752
614-292-9783 Fax
jones.1800@osu.edu

Pablo Jourdan
- Micropropagation
- Genetics
- Breeding of woody plants
- Plant materials

Associate Professor
Department of Horticulture and Crop Science
The Ohio State University
Howlett Hall
2001 Fyffe Court
Columbus, OH 43210-1007
614-292-7224
614-292-3505 Fax
jourdan.1@osu.edu

Jack Kerrigan
- Consumer and environmental horticulture
- Landscape design and plant selection
- Diagnosis of landscape cultural problems
- Communications for media
- Master Gardener Program

Extension Educator and County Director,
Cuyahoga County
Ohio State University Extension
2490 Lee Boulevard, Suite 108
Cleveland Heights, OH 44118-1255
216-397-6000
216-397-3980 Fax
kerrigan.1@osu.edu

Joanne Kick-Raack
- Pesticide training
- Diagnosis of landscape problems
- Nematodes
- Pesticide regulations

Coordinator, Pesticide Applicator Training
Extension Entomology
Ohio State University Extension
249 Howlett Hall
2001 Fyffe Court
Columbus, OH 43210
614-247-7489
614-292-3505 Fax
kick-raack.1@osu.edu

Charles Krause
- Plant disease management
- Application technology research
- Spray drift
- Abiotic disease diagnosis
- Cultivar identification of nursery and greenhouse crops

Plant Pathologist
USDA, Agricultural Research Service

Department of Plant Pathology
Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, Ohio 44691-4096
330-263-3672
330-263-3841 Fax
krause.2@osu.edu

Dennis Lewandowski
- Nursery diseases
- Greenhouse diseases
- Landscape diseases
- Virology

Assistant Professor and Extension Specialist
Department of Plant Pathology
The Ohio State University
201 Kottman Hall
2021 Coffey Road
Columbus, OH 43210
614-292-1293
614-292-1293 Fax

Timothy Malinich
- Consumer horticulture
- Greenhouse production
- Digital media

Extension Educator, Horticulture/Agriculture and Natural Resources, Cuyahoga County
2490 Lee Boulevard, Suite 108
Cleveland Heights, OH 44118-1255
216-397-6000
216-397-3980 Fax
malinich.1@osu.edu

Mary Maloney
- Consumer and environmental horticulture
- Volunteer management
- Curriculum development
- Arboretum programs
- Master Gardener Program

Chadwick Arboretum Education and Volunteer Coordinator
The Ohio State University
264B Howlett Hall
2001 Fyffe Court
Columbus, OH 43210-1096
614-688-3479
614-292-3505 Fax
maloney.23@osu.edu

Jane Martin
- Consumer and environmental horticulture
- Landscape ornamentals and maintenance practices
- Landscaper/homeowner conflict resolution
- Communications for media
- Master Gardener Program

Extension Educator, Horticulture, Franklin County
232C Howlett Hall
2001 Fyffe Court
Columbus, OH 43210
614-247-6046
614-292-3505 Fax
martin.16@osu.edu

Hannah Mathers
- Production
- Nursery and landscape management
- Weed science
- Cold hardiness research
- Spanish newsletter editor
- Buckeye column

Extension Specialist, Nursery and Landscape
Department of Horticulture and Crop Science
Ohio State University Extension
248C Howlett Hall
2001 Fyffe Court
Columbus, OH 43210-1096
614-247-6195
614-292-3505 Fax
mathers.7@osu.edu

Tim Rhodus
- Management
- Economics
- The Internet

Professor, Department of Horticulture and Crop Science
Ohio State University Extension
2001 Fyffe Court
Columbus, OH 43210-1007
614-292-3871
614-292-3505 Fax
rhodus.1@osu.edu

Joe Rimelspach
- Integrated turfgrass health management
- Disease and problem diagnosis of turfgrass
- General turfgrass maintenance

Extension Turfgrass Pathologist
Department of Plant Pathology
Ohio State University Extension
248B Kottman Hall
2021 Coffey Road
Columbus, OH 43210-1087
614-292-9283
614-292-7162 Fax
rimelspach.1@osu.edu

Pamela Sherratt
- Sports turf

Extension Specialist, Sports Turf
Department of Horticulture and Crop Science
Ohio State University Extension
2001 Fyffe Court
Columbus, OH 43210-1007
614-292-7457
614-292-7162 Fax
sherratt.1@osu.edu

Kathy Smith
- Woodland management
- Tree planting

Extension Associate, Forestry
Ohio Woodland Stewards Program Coordinator
School of Natural Resources
210 Kottman Hall
2021 Coffey Road
Columbus, OH 43210
614-688-3136
614-292-7432 Fax
smith.81@osu.edu

Dave Shetlar
- Ornamental tree and shrub entomology
- Turfgrass entomology
- Christmas tree entomology
- Pest monitoring and detection
- IPM

Associate Professor, Extension Entomology
Ohio State University Extension
1991 Kenny Road
Columbus, OH 43210-1000
614-292-3762
614-292-9783 Fax
shetlar.1@osu.edu

Tom Shockey
- Garden center employee training
- Department of Horticulture and Crop Science intern placement
- Consumer horticulture
- Youth gardening project evaluation

Extension Associate/Student Services Coordinator
Department of Horticulture and Crop Science
Ohio State University Extension
257A Howlett Hall
2001 Fyffe Court
Columbus, OH 43210-1007
614-292-3846
614-292-3505 Fax
shockey.2@osu.edu

Larry Steward
- Nursery management

Associate Professor and Technical Coordinator, Nursery Management
Horticultural Technologies
Ohio State University Agricultural Technical Institute
1328 Halterman Hall
1328 Dover Road
Wooster, OH 44691
330-264-3911 Ext. 1265
330-263-7634
steward.31@osu.edu

Amy Stone
- Consumer and environmental horticulture
- Green industry training
- Landscape maintenance practices
- Master Gardener Program
- Gypsy moth education

Extension Educator, Consumer and Urban Horticulture, Lucas County
Ohio State University Extension
5403 Elmer Drive, Building #8
Toledo, OH 43615
419-578-6783
419-243-6684 (MOTH)

419-578-5367 Fax
stone.91@osu.edu

John Street
- Turfgrass management
- Turfgrass fertilization
- Turfgrass weed control
- Fate of pesticides and nitrogen in turf

Associate Professor and Extension Specialist, Turfgrass
Department of Horticulture and Crop Science
Ohio State University Extension
2021 Coffey Road
Columbus, OH 43210-1007
614-292-9091
614-292-7162 Fax
street.1@osu.edu

Daniel Struve
- Production systems for woody plants
- Seed propagation
- Plant selection
- Plant establishment

Professor, Department of Horticulture and Crop Science
The Ohio State University
241B Howlett Hall
2001 Fyffe Court
Columbus, OH 43210
614-292-3853
614-292-3505 Fax
struve.1@osu.edu

Nancy Taylor
- Diagnosis of plant diseases
- Diagnosis of ornamental, tree, and shrub diseases
- Coordinator of the C. Wayne Ellett Plant and Pest Diagnostic Clinic

Program Director, Department of Plant Pathology
C. Wayne Ellett Plant and Pest Diagnostic Clinic
The Ohio State University
201 Kottman Hall
2021 Coffey Road
Columbus, OH 43210-1087
614-688-5563
614-292-4455 Fax
taylor.8@osu.edu

Sharon Treaster
- Landscape maintenance
- Woody plant identification
- Consumer and environmental horticulture

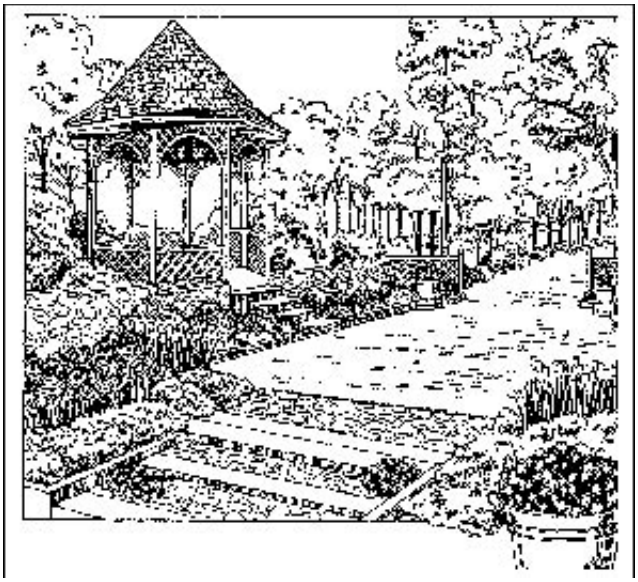
Laboratory Technologist
Department of Horticulture and Crop Science
The Ohio State University
248D Howlett Hall
2001 Fyffe Court
Columbus, OH 43210-1007
614-292-1395
614-292-3505 Fax
treaster.1@osu.edu

Curtis Young
- IPM
- Insect identification and management

Extension Educator, Agriculture, Allen County
Ohio State University Extension
3900 Campus Drive, Suite B
Lima, OH 45804-3596
419-222-9946
419-228-3601 Fax
young.2@osu.edu

Randy Zondag
- Commercial nursery production (field and container, fertility, pesticide safety, and water quality)
- Landscape installation and maintenance
- IPM
- Soils
- Greenhouse management
- Fruit production

Extension Educator, Horticulture, and County Director, Lake County
Ohio State University Extension
99 East Erie Street
Painesville, OH 44077-3907
440-350-2269
440-350-5928 Fax
zondag.1@osu.edu



During the growing season, the team teleconferences weekly and develops a newsletter called the Buckeye Yard and Garden Line, which is available by a fax subscription service (contact a local team member) or on the World-Wide Web at:

http://www.hcs.ohio-state.edu/hcs/hcs.html

(Ohio State University Department of Horticulture and Crop Science, Horticulture and Crop Science in Virtual Perspective)

Buckeye Yard and Garden Line
Fax Centers

Clark County	Pam Bennett
Clermont County	Gary Gao
Cuyahoga County	Tim Malinich
Franklin County	Jane Martin
Hamilton County	Joe Boggs
Lake County	Randy Zondag
Lucas County	Amy Stone
Montgomery County	Pete Lane
Putnam County	Glen Arnold

’’’

~ 2 ~

Floriculture Industry Roundtable of Ohio

Financially supported by the Floriculture Industry Research Scholarship Trust (FIRST)

Our Mission

The mission of the Floriculture Roundtable of Ohio is to provide an educational forum to floriculture Extension personnel, growers, and members of the allied industries across the Midwestern region, currently including Ohio, Michigan, Pennsylvania, Kentucky, and Indiana, for the exchange, discussion, and dissemination of information related to floriculture.

Serving You

Do you ever have problems with crops? The Roundtable offers you free assistance in finding solutions. All persons listed in this directory are just a phone call away. Take advantage of the opportunity!

Directory developed by Charles Behnke, Ohio State University Extension, Lorain County, and Claudio Pasian, The Ohio State University, Department of Horticulture and Crop Science.

Greenhouse Management

Behnke, Charles
Dyke, Dave
Everett, Craig
Frantz, Jonathan
Gao, Gary
Kneen, Hal
Krauskopf, Dean
McMahon, Peg
McMahon, Robert W. (Bob)
Metzger, Jim
Pasian, Claudio

Plant Pathology

Ellsworth, Denise
Lewandowski, Dennis
Locke, James
Taylor, Nancy

Entomology/IPM

Cañas, Luis
Cloyd, Raymond
McMahon, Robert W. (Bob)

Food, Agricultural, and Biological Engineering/Greenhouse Environment

Brugger, Mike
Frantz, Jonathan
Ling, Peter

Management and Economics

Barrett, Eric
Dyke, Dave
Kneen, Hal
Rhodus, Tim

Composting

Watson, Maurice

Crop Physiology

Carver, Steve
Frantz, Jonathan
Jones, Michelle
McMahon, Peg
Metzger, Jim
Pasian, Claudio

Nutrient Analysis/Water Quality

Carver, Steve
Frantz, Jonathan
Krauskopf, Dean
Pasian, Claudio
Watson, Maurice

Postharvest Physiology

Jones, Michelle

Applied Economics/Internet Communications

Tim Rhodus

Team Members

Eric Barrett
OSU Extension Educator and County Director, Agriculture, Washington County
206 Davis Avenue
Marietta, OH 45750-3089
740-376-7431
740-376-7084
barrett.90@osu.edu

- Direct marketing — image and promotions
- Small-business management
- Human-resource management

Charles Behnke
OSU Extension Educator, Horticulture, Lorain County
42110 Russia Road
Elyria, OH 44035-6815
440-326-5859
440-326-5878 Fax
behnke.1@osu.edu

- Greenhouse management
- Garden center employee training

Mike Brugger
Associate Professor, Food, Agricultural, and Biological Engineering
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3636
330-263-3670 Fax
brugger.1@osu.edu

- Greenhouse production systems with special emphasis on ventilation and control systems

Luis Cañas
Assistant Professor, Insect Ecology in Controlled Environments
Department of Entomology
Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691-4096

330-263-3818
330-263-3686 Fax
canas.4@osu.edu

- IPM of crops in controlled environments
- Evaluation of pest-management practices including sanitation, cultural control, biological control, pesticide use
- Biological control use and its compatibility with pest control materials

Steve Carver

Ohio Florists Association
Membership/Technical Education Coordinator
2130 Stella Court
Columbus, OH 43215
614-487-1117
614-487-1216
scarver@ofa.org

- Production/post-production physiology
- Plant nutrition
- Greenhouse management

Raymond A. Cloyd

Assistant Professor, Extension Specialist in Ornamental Entomology/IPM
Department of Natural Resources and Environmental Sciences
University of Illinois
384 National Soybean Research Laboratory
1101 West Peabody Drive
Urbana, IL 61801
217-244-3469
217-333-4777 Fax
rcloyd@uiuc.edu

- Integrated pest management and biological control of greenhouse pests
- Effects of plants on natural enemy foraging success
- Compatibility of pest control materials with natural enemies
- Efficacy of new pest control materials
- Tank mix compatibility
- Effect of nutrition on pests

Mary Donnell

OSU Extension Educator, Commercial Horticulture/Agricultural Economic Development
Agricultural Business Enhancement Center
440 E. Poe Road, Suite 201
Bowling Green, OH 43401-1351
419-354-6916
419-354-6416 Fax
donnell.8@osu.edu

- Marketing
- Business management
- Hydroponic vegetable production
- Greenhouse management

Dave Dyke

OSU Extension Educator, Commercial Floriculture, Hamilton County
110 Boggs Lane, Suite 315
Cincinnati, OH 45246-3145
513-946-8983
513-505-1202 Cell phone
513-528-0034 Fax
dyke.15@osu.edu

- Greenhouse management
- Small business management
- Marketing

Denise Ellsworth

OSU Extension Educator, Horticulture, Summit County
2525 State Road, Suite 250
Cuyahoga Falls, OH 44223-1602
330-928-4769 (330-928-GROW) Ext. 21
330-928-9418 Fax
ellsworth.2@osu.edu

- Integrated pest management
- Plant diseases

Craig Everett

OSU Extension Program Assistant, Horticulture, Wood County
440 E. Poe Road, Suite A
Bowling Green, OH 43402
419-354-9050
419-352-7413 Fax
everett.33@osu.edu

- Greenhouse management and production

Frantz, Jonathan
Research Horticulturist, USDA-ARS
2801 W. Bancroft, Mail Stop 604
Toledo, OH 43606
419-530-1531
419-530-1599 Fax

- Greenhouse management
- Agricultural engineering/greenhouse environment
- Crop physiology
- Nutrient water analysis
- Water quality

Gary Gao
OSU Extension Educator, Horticulture, and County Director, Clermont County
P. O. Box 670, 1000 Locust Street
Owensville, OH 45160
513-732-7070
513-732-7060 Fax
gao.2@osu.edu

- Greenhouse management

Michelle L. Jones
Assistant Professor, Floriculture/Molecular Biology
Department of Horticulture and Crop Science
Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3885
330-263-3887 Fax
jones.1968@osu.edu

- Production/post-production physiology
- Biotechnology
- Germplasm enhancement
- Ethylene

Hal Kneen
OSU Extension Educator, Horticulture, Meigs County
Mulberry Heights
P. O. Box 32
Pomeroy, OH 45769
740-992-6696
740-992-7931 Fax
kneen.1@osu.edu

- Greenhouse management
- Small-business management
- Production economics
- Marketing

Dean Krauskopf
Greenhouse Educator, Southeast Michigan
Michigan State University
MSU Extension — Southeast Region
28115 Meadowbrook Road
Novi, MI 28115
248-347-0269
248-380-9193 Fax
krauskop@msu.edu

- Greenhouse crop nutrition
- Foliar and media analysis
- Greenhouse crop management

Dennis Lewandowski
Assistant Professor and Extension Specialist
Department of Plant Pathology
The Ohio State University
201 Kottman Hall
2021 Coffey Road
Columbus, OH 43210
614-292-1293
614-292-1293 Fax

Peter Ling
Assistant Professor
Food, Agricultural, and Biological Engineering
Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691-4096
330-263-3857
330-263-3670 Fax
ling.23@osu.edu

- Greenhouse automation
- Irrigation management
- Climate control
- Energy management

James Locke
Research Plant Pathologist, USDA, ARS, ATRU
Greenhouse Production Research Group
2801 W. Bancroft St., Mail Stop 604
Toledo, OH 43606
419-530-1595
419-430-1599 Fax
James.Locke@utoledo.edu

- Disease control of floricultural crops
- Greenhouse production
- Alternative disease control product development

Margaret (Peg) McMahon
Associate Professor
Department of Horticulture and Crop Science
The Ohio State University
2001 Fyffe Court
Columbus, OH 43210
614-292-8867
614-292-3505 Fax
mcmahon.43@osu.edu

- Floriculture crop physiology
- Light quality regulation of crop development
- Greenhouse management
- Production of floriculture crops

Robert W. (Bob) McMahon
Professor
The Ohio State University
Agricultural Technical Institute
1328 Dover Road
Wooster, OH 44691-4000
800-647-8283 Ext. 1320 (Ohio only)
330-264-3911 Ext. 1320
330-262-7634 Fax

- IPM
- Control of insect pests of floriculture crops with natural enemies and use of hot-water drenches and sprays, and manipulation of plant height by environmental manipulation (water and temperature)
- Greenhouse production and management

James (Jim) Metzger
Professor
Department of Horticulture and Crop Science
The Ohio State University
2001 Fyffe Court
Columbus, OH 43210
614-292-3854
614-292-7162 Fax
metzger.72@osu.edu

- Role of hormones in plant growth and development
- Environmental control of flowering
- Use of biotechnology to improve floricultural crops

Claudio Pasian
Associate Professor and Extension Specialist, Floriculture
Department of Horticulture and Crop Science
The Ohio State University
2001 Fyffe Court
Columbus, OH 43210
614-292-9941
614-292-3505 Fax
pasian.1@osu.edu

- Production and management
- Modeling and timing of floricultural crops
- Water quality and nutrition of floricultural crops

Tim Rhodus
Professor
Department of Horticulture and Crop Science
The Ohio State University
2001 Fyffe Court
Columbus, OH 43210
614-292-3871
614-292-3505 Fax
rhodus.1@osu.edu

- Management and economics of horticultural crops
- Multimedia applications for marketing and education

Nancy Taylor
Director, C. Wayne Ellett Plant and Pest Diagnostic Clinic
The Ohio State University
110 Kottman Hall
2021 Coffey Road
Columbus, OH 43210
614-688-5563
614-292-4455 Fax
taylor.8@osu.edu

- Diagnosis of diseases of floral and other greenhouse crops

Watson, Maurice
Associate Professor and Extension Soil Specialist
School of Natural Resources
Ohio Agricultural Research and Development Center
The Ohio State University
1680 Madison Avenue
Wooster, OH 44691
330-263-3755
330-263-3658 Fax
watson.8@osu.edu

- Analysis of soil, soilless mix, sewage sludges, manures, and water
- Water quality, composting, and environmental pollution problems

Floriculture Industry Roundtable of Ohio (FIROO) Activities Include:

- Assisting growers with crop production problems.
- Holding biweekly conference calls to assess the state of the industry. These calls are used as an educational forum by Roundtable members. Grower participation in the biweekly phone calls is possible (and encouraged) on a port-available basis by contacting Charles Behnke at 440-326-5859 prior to the biweekly conference.
- Preparing and faxing out informational alerts (FIROOFAX) to industry members when emergencies arise.
- Collaborating with the Ohio Florists Association and other regional grower associations in the organization of educational seminars and workshops.

Feel free to get in touch with any of the Roundtable members listed in this Directory if you have any floricultural problem or wish to share information.

”””

~ 3 ~

Weather Summary and Environmental Problems of Ornamental Plants in Ohio: 2005

Pamela J. Bennett

Introduction

This report is a compilation of Ohio weather conditions and noteworthy environmentally induced plant problems in 2005. Observations were drawn from information provided in Ohio State University Extension's Buckeye Yard and Garden Line, the Ohio Department of Natural Resources Monthly Water Inventory Report, and the Ohio Agricultural Research and Development Center weather stations located across the state.

Discussion

Weather Background

This section focuses on the precipitation and temperature reports for the growing season. The tables show statewide precipitation results from January through September, the number of days with temperatures 90ºF or greater, and the temperatures and departures from normal.

Precipitation

January precipitation was above normal statewide. The average for the state was 7.11", which was 4.54" above normal. For the state as a whole, this was the fourth wettest January during the past 123 years. Precipitation fell as both rain and snow, with the bulk of the month's precipitation occurring during the first 13 days. Nearly all of it was rain in the southern two thirds of the state.

February had below normal precipitation amounts. The average for the state as a whole was 1.75"; this was 0.51" below normal. Precipitation fell as both rain and snow. Chardon (Geauga County) reported 16.5" of snow for the month, which was actually 4" below normal. However, for the season, Chardon had 117" of snow for the year, about 34" above normal.

In March, precipitation was generally below normal across the northern half of Ohio and near or above normal in the southern half. Butler County reported the greatest amount of precipitation with 5.10", and Ottawa County reported the least with 0.50".

Most of the state received above normal precipitation amounts during April. In the extreme northwestern and southwestern areas, however, it was below normal. The state average was 4.60"; this was 1.02" above normal. Again, Chardon reported

Pamela J. Bennett, Horticulture Educator, Clark County

the greatest amount of April precipitation with 8.17". Williams County had the least amount of precipitation with 1.59". In northeastern Ohio, 3 to 10" of snow fell, causing broken branches and tree damage as well as downed power lines.

May precipitation was below normal for most of the state, with only a few locations in east-central Ohio above normal. The average for the state was 2.51", which was 1.40" below normal. The first 10 days of the month were extremely dry statewide. The first significant precipitation of the month was during May 11 to 14 when showers and thunderstorms dropped between 0.50" and 1.50" of rain.

June was noticeably dry. Precipitation was below normal throughout most of the state except for a few areas in extreme western Ohio where it was above normal. It was the third driest June for the state as a whole in 123 years. The most widespread precipitation for the month was during the last week. Amounts were greatest in the southwestern two thirds of the state with some areas receiving as much as 2 to 4" of much-needed rain.

Precipitation in July varied greatly across the state; the northern half of Ohio was above normal and the southern half below normal. Greene County reported the least amount of rain with 1.40". Many locations didn't have any rain for the first 11 days of the month. Typical summer systems of hit-or-miss showers prevailed. According to the Palmer Drought Severity Index, the central, southwestern, and south-central regions were classified as being in a moderate drought near the end of July.

Overall, August precipitation was above normal across most of the state but below normal in northwestern Ohio and a few areas of north-central and southern Ohio. Areas of Knox and Franklin County reported around 8" of rain, while Defiance County reported the least amount with 0.91". The first 24 days were rather dry across most of the state. The most widespread rain for the month was a result of Hurricane Katrina, which moved through Ohio in late August and produced a steady rain and occasional heavier downpours.

Precipitation was above normal during September through most of the state. However, the southeastern quarter of the state was generally below normal. Areas of Champaign County reported the most rain with 7.48", and Scioto County reported the least with 0.72". The first half of the month was extremely dry.

Table 1. 2005 Statewide Precipitation, January through September.

Month	Average Precipitation Inches	Above or Below Normal
January	7.11	+4.54
February	1.75	-0.51
March	2.58	-0.59
April	4.60	+1.02
May	2.51	-1.40
June	1.80	-2.05
July	4.32	+0.24
August	4.93	+1.49

Temperature

Temperatures were generally cooler than normal across the state in April and May and warmer than normal during June, July, and August. The summers of 2003 and 2004 have been cooler than 2002 and 2005. See Table 2 for summary of days 90ºF or more in the last four growing seasons — June, July, and August.

Table 3 is a breakdown of the number of days 90ºF or above for the 2005 season.

Table 2. Number of Days 90ºF or More in June, July, and August.

	2002	2003	2004	2005
Cleveland	21	5	0	24
Columbus	30	5	2	32
Cincinnati	37	5	4	31

Table 3. Number of Days 90°F or Above, June – September 2005.

Location	June	July	August	September	Season Total
Fremont	11	7	6	0	24
Columbus	12	8	12	0	32
Cincinnati	8	7	16	0	31

Table 4. Temperature in Selected Cities, April through September 2005.

	Fremont		Columbus		Cincinnati	
Month	**Avg. Temp. F°**	**Departure F°**	**Ave. Temp F°**	**Departure F°**	**Ave. Temp F°**	**Departure F°**
April	48.2	-0.20	53.8	+2.7	52.3	-0.70
May	54.0	-5.20	59.0	-2.40	56.6	-5.60
June	72.0	+2.90	74.5	+4.10	71.2	+0.70
July	73.1	+0.20	76.5	+2.3	74.5	+0.04
August	70.8	+0.10	75.7	+3.10	74.3	+1.60
September	65.0	+1.30	69.2	+3.10	NA	NA
Source: Average temperature is an average of all high and low temperatures recorded daily for the given location.						
Data for Fremont was taken from the OARDC Fremont site: http://www.oardc.ohio-state.edu/centernet/stations/vehome.asp						

Useful web sites for weather-related topics are listed here:

Ohio Department of Natural Resources
Division of Water
Monthly Water Inventory Report
http://www.dnr.state.oh.us/water/

National Oceanic and Atmospheric Administration (NOAA)
drought report
http://www.drought.noaa.gov/

USDA Topsoil Moisture Chart
http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/topsoil.html

OARDC Weather Stations
http://www.oardc.ohio-state.edu/centernet/weather.htm

Degree day, phenology update for Ohio
http://www.oardc.ohio-state.edu/gdd

Environmental Problems in Landscapes

Early Fall Coloration

There are many valid reasons for plants to show fall coloration earlier than usual during a growing season. Reasons include but are not limited to:

- Stresses such as hot dry weather and other environmental factors, such as soil compaction, as well as physical damage to the base of the plant from mowers or trimmers.
- High rust mite populations and their feeding injury give the plant a "bronzing" appearance.
- Foliage diseases such as rust or scab cause leaves to yellow and drop, or powdery mildew may cause reddening of the leaves.
- The plant might just be predisposed to this as a result of genetics.

It is important to notice and pay close attention to what is going on with the plant. Inspect plants for signs of borers, other insect damage, or other physical damage. Look to see if there is something harming the root zone. For instance, a groundhog may have decided to make a home there. Pay extra attention to the water needs, especially during prolonged dry spells.

This past season, early fall coloration was observed in burning bush (Euonymus alatus) even as early as the end of June in some areas of the state. Other plants noted as showing fall color in August included red maple (Acer rubrum), tulip poplar (Liriodendron tulipifera), and Eastern redbud (Cercis canadensis).

Conifer Challenges

OARDC researcher Dan Herms noted that Ohio weather patterns in 2005 were very similar to those experienced in 1999. During that year, prolonged drought and onerous heat stressed many conifers growing in undesirable locations, thus making the plants susceptible to bark beetles. Ohio experienced dry weather patterns in 2005 that may set up some conifers for problems.

The primary bark beetle species in Ohio (Ips spp. and Dendroctonus spp.) do not attack healthy trees; however, the burrowing of the larvae under the bark, the loss of sap, and diminished nutrient uptake add the final drop of doom for conifers already stressed by poor environmental or cultural conditions.

Before planting, one can improve the chance of pines, spruces, and firs surviving inevitable periods of drought by planting them in well-drained, but deep, organic

soil, or by amending the soil with organic matter before planting. Do not plant where the root zones will be inhibited in a few years or in low, wet areas or hot, dry clay soils. Plant at the correct depth and remove burlap, when possible.

If the tree has already been planted and is in a stressed situation, place 1 to 2" of mulch under the drip line and soak the soil at least every 14 days. Avoid digging near the root zone and treat for disease and insect problems as needed.

Bark beetles detect chemicals emitted by stressed trees. They release their own aggregation pheromone once they find a "good tree," calling more bark beetles to the feast. The resultant attack of numerous beetles and extensive tunneling from the larvae often lead to the eventual death of the tree.

During periods of drought, prevent potential conifer bark beetle infestations on specimen landscape pines by spraying the trunks of stressed evergreens with tree borer formulations of bifenthrin (e.g., Astro) or permethrin (e.g., Onyx) around August 1, before the next large generation of adults emerges. However, it is very important to note if trees are already infested with bark beetles or are in such an acute state of decline that no cultural practices will revive their health. In these situations, bark applications of insecticides will not prevent the eventual death of the tree.

Maple Seed Mania Causes Concern

In early spring, it was noted that maples had sparse foliage due to all of the seeds that had developed on maple trees. Normal leaf development was slowed and reduced because the seeds used most of the trees' stored resources to ripen the heavy seed crop. The seeds matured, turned brown, and eventually dropped, clogging gutters and littering the landscape. Once the seeds fell, people noticed the "thinning canopy" and were worried about the health of the trees.

Maple seed production was quite heavy in 2005 and could be attributed to various environmental factors and the growing conditions of the previous summer and fall, as well as the current spring. Warm, sunny days prior to the onset of winter favor flower bud formation in many trees, including maples. In addition, spring weather conditions promoted good flowering; there were no freezes to prevent development of some of the potential seeds.

Transplant Shock Issues

Transplant shock on materials planted the previous summer and late fall was observed as reduced growth and injury to the crowns of plants.

Transplant shock refers to the period of reduced growth following transplanting. The impact of transplant shock is often worse in the first year; however, effects can occur up to three years after transplanting. Transplant shock can be expressed in the same manner as root injury from cold temperatures. Usually the effects are plants flushing much later than normal in the spring, retarded or slower growth throughout the growing season, increased susceptibility to root rot or other disease pathogens, and shoot dieback and death — if severe enough.

Young roots are often on the outside edge of the container, or the root ball (B&B), and are the first injured by cold temperatures. Injury to these young tender roots ends up as transplant shock. Young roots are required for calcium (Ca) uptake, and Ca is necessary for young root formation.

Once young roots are injured, it is hard to correct the problem. Thus, plants flush later and show reduced or retarded growth, etc.

Over-wintering practices should protect mature and young roots from injury, especially when newly transplanted onto a site in the fall. Watering the plant correctly during time of establishment and ensuring that the plant doesn't go into the winter dry can help ease some transplant shock issues.

Plants suffering from transplant shock and/or root injury may leaf out, only to desiccate and wilt later when the plant needs to draw on its conducting tissue (roots) to transport water. Other common winter injury problems are bark splitting and collar injury.

References

Jeffery Rogers, State Climatologist, with the State Climatologist's Office for Ohio, provides current and archived weather information for several locations in the state. This information is available at: http://www.geography.ohio-state.edu/faculty/rogers/statclim.html

The OARDC Weather Stations: http://www.oardc.ohio-state.edu/centernet/weather.htm

The Buckeye Yard and Garden online is available at: bygl.osu.edu

”

~ 4 ~

Insect Galls

Joseph F. Boggs

Few plant disorders provoke a wider range of reactions from observers than plant galls. To some, plant galls are a source of wonder. To others, they are a source of abhorrence. In his pivotal 1917 USDA publication, Key to American Insect Galls, Ephraim Porter Felt best expressed the wonder of galls when he wrote: "Insect galls are obvious and frequently excite surprise because of the strange form or the wonderful coloring and delicacy of structure."

What is a plant gall? The answer speaks directly to the reason galls are viewed so differently, depending upon who is doing the viewing. Plant galls are sometimes defined as simply being unusual plant growths. This is partly right. Galls are plant growths, and they are unusual, but this definition could encompass a tree's response to getting hit by a lawn mower. The rotary irritant could indeed produce unusual growths on the tree trunk, but the growths are not galls. This simple gall definition misses the most fascinating aspect of plant galls.

Galls are indeed unusual plant growths. However, they are induced and their growth is directed through a continual interaction with a living gall-maker. In the case of insect and mite galls, gall-makers may actually produce plant hormones, or hormone analogs. The gall-forming process is usually initiated by the female when she lays eggs. Once the eggs hatch, the interaction continues with the immature gall-makers continuing to produce plant hormones, thus directing plant growth to suit their needs. The second part of this more accurate definition speaks to why some find insect and mite plant galls so fascinating.

Gall-makers encompass a wide array of organisms from insects to mites to nematodes to microorganisms such as bacteria and fungi. The most common insect gall-makers belong to only a few orders with Hymenoptera, Diptera, and Homoptera providing the greatest cast of characters. Mite gall-makers are dominated by one group, the unusual carrot-shaped Eriophyid mites.

All of these gall-makers have a few things in common. First, they have an intimate relationship with their host plant. Indeed, the association is termed an "obligate host-parasite" relationship, meaning that the parasite is obliged to make a living off its host — it has no alternative. Second, the host-parasite relationship is so specific that the gall-maker produces only one type of gall on its host and the maker can be identified to species just by examining the gall structure, without the need to

Joseph F. Boggs, Ohio State University Extension, Hamilton County, and the OSU Extension Center at Piketon.

actually observe the gall-maker. Finally, galls grow from developing plant tissue. This means that once the plant tissue stops differentiating and expanding, galls cannot develop. For example, once leaves fully expand, leaf galls cannot develop.

Some gall-makers, such as the spiny witchhazel aphid (Hamamelistes spinosus), develop relationships with two different hosts, in two plant families. This aphid alternates between witchhazel (Hamamelis spp.) and birch (Betula spp.). The occurrence of alternating hosts in a gall-maker's life cycle adds to pest management challenges since both hosts must be considered.

On witchhazel, the aphid highjacks a plant bud, causing it to grow into a spiny gall (Figure 1). On birch, the aphid resides on the underside of leaves where it sucks plant juices, causing expanding leaves to develop unsightly corrugated folds (Figure 2). Despite this insect's common name, the galls on witchhazel are almost inconsequential; however, the damage to birch is very noticeable.

Other gall-makers, such as the horned oak gall wasp (Callirhytis cornigera), develop intimate relationships between different parts of the same host plant. The life cycle of this wasp includes one generation spent

Figure 1. Ants tending a spiny witchhazel aphid gall on witchhazel.

Figure 2. Undamaged birch leaf on left; leaf damage from spiny witchhazel aphid on right.

inside insignificant leaf galls that appear as small bumps on leaf veins. This stage lasts for one season, and the galls are difficult to detect with an untrained eye.

The next generation is spent in very obvious and significant woody, gnarled stem galls that arise from twigs and branches (Figure 3). The galls incorporate vascular tissue within their structure, and the tissue may become so disorganized that the flow of water and nutrients is disrupted, causing branches and twigs beyond the galls to die (Figure 4). The

Figure 3. Mature horned oak gall with "horns" extended.

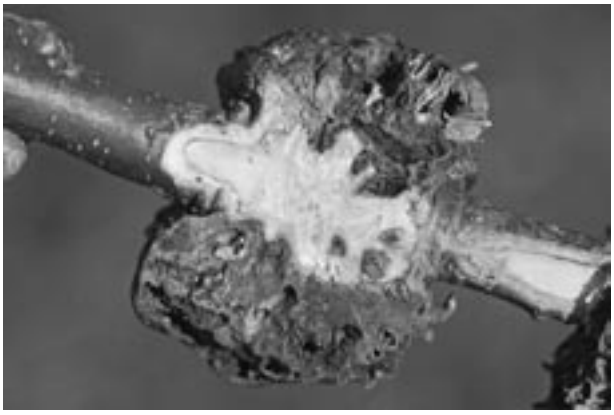


Figure 4. Horned oak gall opened to reveal disorganized vascular tissue.

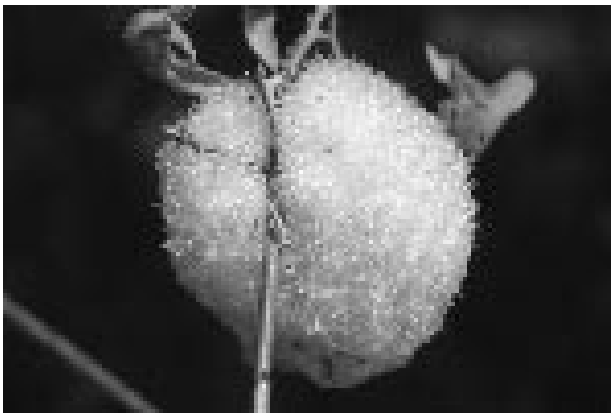


Figure 5. Wool sower gall on oak.

wasp spends almost three years in the stem-gall stage, with the galls growing larger each year. Shortly before the wasps emerge, the cone-shaped gall structures that housed the wasps throughout their larval development rise to the surface, presumably to aid the wasps in emerging from the galls. These structures are the "horns" of the horned oak gall.

Management strategies for the horned oak gall wasp must take into account the two locations where the gall-maker resides. Adding to the complexity is that nothing is synchronized. Leaf galls occur every year, providing a constant stream of wasps that will produce stem galls. The annual reservoir of wasps dedicated to producing stem galls makes managing horned oak gall by pruning out infested stems a never-ending process.

There are around 800 insect galls that can occur on oak, and while many of the galls are dramatic in their appearance, the vast majority cause no harm to the host. A good example is the wool sower gall produced by the wasp Callirhytis seminator (Figure 5). This wasp belongs to the same family as the horned oak gall wasp (Cynipidae); however, the two wasps have little else in common.

While horned oak galls may appear as simple expansions of woody stem tissue, wool sower galls look like nothing that should be produced by an oak tree. The distinctive galls arise from lateral twig buds and are described as being about the same size and looking like cotton balls, or marshmallows. Cutting the galls in half reveals why they cause no harm to their hosts (Figure 6). The galls do not incorporate the vascular stem tissue of the twig they are attached to, so the twig beyond the gall is not affected.

Other insects beyond gall-makers may also have close relationships with plant galls. Research conducted by Eileen Buss (Entomology, University of Florida) as part of her Ph.D. work at the University of Kentucky revealed that a complex of more than 20 wasps live in horned oak galls, although it appears that only C. cornigera

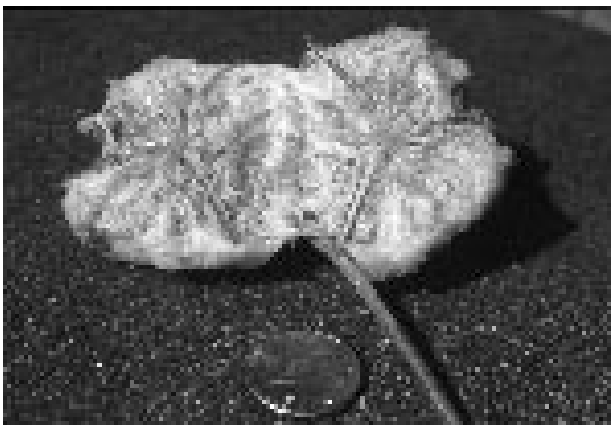


Figure 6. Wool sower gall opened to reveal internal structure.

is responsible for gall formation. She also noted that a number of non-wasp insects lived in the galls, including the dogwood borer (Synanthedon scitula) (Figure 7). Around 15 percent of the two- to three-year-old galls she used in her research were infested with dogwood borer. The clearwing moth caterpillars tunnel through and consume the galls much the same way they bore through the phloem tissue of their dogwood hosts. Figure 8 shows a dogwood borer pupa in a horned oak gall. The pupa is surrounded by frass produced by the caterpillar as it bored through the gall.

Galls or gall-makers may exude liquids that attract insects. Figure 3 shows droplets of sugary liquid oozing from the tips of the "horns" of horned oak gall. It is speculated that the liquid may entice ants to "tend" and protect the galls, thus protecting the emerging gall-wasps, much the same way honeydew exuded by aphids draws ants to the aphid's defense. This ant-aphid relationship is demonstrated with the spiny witchhazel aphid gall in Figure 1. The gall has opened at the base, allowing ants surrounding the gall direct access to honeydew exuded by the gall-making aphids.

The fact that most insect and mite galls cause no harm to their hosts may be

Figure 7. Dogwood borer clearwing moth from horned oak gall.

Figure 8. Dogwood borer pupa in horned oak gall.

cold-comfort to nursery and landscape managers, since the galls certainly affect the expected and desired appearance of the host. Couple this with the reality that gall-makers are difficult to control, primarily because their life cycles are often poorly understood, and it is little wonder that insect and mite galls are commonly viewed with equal doses of fascination and frustration.

However, imagine the intricate physiological and chemical dance that must occur between the gall-maker and the host for such unusual and unique plant structures to form. Insect and mite gall-makers secrete chemicals at just the right time, and at just the right dosages to turn on and off plant genes in just the right order to produce plant growths that are not just unusual, but totally unexpected for the host plant. Oak trees do not normally grow "cotton balls." Only the wool sower gall wasp can do this.

If not viewed with a sense of wonder and fascination, at least insect and mite gall-makers should garner begrudging respect. So far, no human has managed to duplicate work so handily done by a group of organisms that are often viewed with disdain. Imagine the plant secrets that would be unlocked if we could?

,,,

~ 5 ~

The BackPocket Gardener

Jane A. Martin, Jane Wright, Barbara Bloetscher, David E. Dyke,
Erik A. Draper, Pamela J. Bennett, Gary Y. Gao, Joseph F. Boggs,
David J. Shetlar, Amy K. Stone, Timothy J. Malinich, and James A. Chatfield

The BackPocket Gardener is an upcoming publication of the Ohio Nursery and Landscape Association (ONLA) and the Ohio State University Extension Nursery Landscape and Turf Team (ENLTT). Subtitled Volume 1: Getting Started, this new publication is a practical guide for garden center professionals — and their customers — to use in the hubbub of garden center chaos during the growing season. It answers questions such as:

Q. — Why are flowers on annuals often deadheaded?

A. — Deadheading is the removal of spent flowers in order to keep the annual plant from going to seed and to help prevent disease (such as gray mold) from spreading from the fading flower to the leaves. Remove the entire flower stalk when deadheading.

Q. — Why do I have lush tomato and pepper plants but no peppers or tomatoes?

A. — For tomatoes, peppers, and eggplants, nitrogen (N) should be limited until the plants have set their first fruits which have grown to about the size of a golf ball. If excess N is used too early on these plants, you get a lush plant at the expense of flowers and fruits.

Q. — Do grass clippings cause thatch?

A. — No, grass clippings are 90% water and do not contribute to the spongy layer called thatch that can be a problem as it gets too thick. As clippings degrade, water, organic matter, and nutrients are recycled to the soil and thus the turfgrass. This is why mulching mowers are recommended.

Q. — How deep should mulch be applied?

A. — Organic mulch, such as composted bark, is great for moisture and temperature moderation, weed control, and preventing damage to tree bark with weed whips and lawn mowers. It is also attractive. But keep the depth down to 2 to 2-1/2 inches or maybe a little deeper if the soil is sandy and well-drained. Otherwise

Jane A. Martin, Ohio State University Extension, Franklin County; Jane Wright, OSU Extension, Franklin County Master Gardener Volunteer; Barbara Bloetscher, Ohio State University Extension, C. Wayne Ellett Plant and Pest Diagnostic Clinic, Entomology; David E. Dyke, Ohio State University Extension, Hamilton County; Erik A. Draper, Ohio State University Extension, Geauga County; Pamela J. Bennett, Ohio State University Extension, Clark County; Gary Y. Gao, Ohio State University Extension, Clermont County; Joseph F. Boggs, Ohio State University Extension, Hamilton County, and the OSU Extension Center at Piketon; David J. Shetlar, Ohio State University Extension, Ohio Agricultural Research and Development Center, Associate Professor of Urban Landscape Entomology; Amy K. Stone, Ohio State University Extension, Lucas County; Timothy J. Malinich, Ohio State University Extension, Cuyahoga County; and James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science.

the overly deep mulch stays too wet and can rot trunks, limit oxygen to roots, and provide a home for bark-damaging rodents in winter.

Q. — What are some good annuals for shade?

A. — Phlox, balsam, begonia, calendula, coleus, lobelia, flowering tobacco, forget-me-not, four o'clock, impatiens, larkspur, nasturtium, nemesia, New Guinea impatiens, pansy, and wishbone plant.

Q. — How much sunlight does my pond need?

A. — Your pond should receive at least 6 hours of direct sunlight per day. About 1/2 to 1/3 of its surface should be exposed to direct sun. Too much light will encourage the growth of algae, and over-heated water can be harmful to animal life. Too little light can also result in water that is cooler than desirable for animal life.

Q. — What are the site requirements for growing roses?

A. —
- At least 6 hours of direct sunlight, though full sun is preferable.
- Avoid planting near trees and shrubs that compete for moisture and nutrients.
- An "open" site to allow for air movement around the planting (lessens disease potential).
- Good water drainage; roses will decline if there is standing water around roots.

As can be seen from these examples, The BackPocket Gardener is not intended as an extensive reference, but rather as a short, user-friendly guide for quick guidance. Other references are needed for more detailed questions. It contains a number of chapters, from Soil Basics to Vegetables, from Herbaceous Perennials to Roses. If you are a rosarian (as opposed to a normalian), this is your lucky day. Here is the full BackPocket Gardener section on roses.

Ten Most-Commonly Asked Questions About Roses

Q. — What are the black spots on my roses, and how do I get rid of them?

A. — Black spot is a common fungal disease that causes irregular black spots on rose leaves and stems. Spotting usually begins on the lower leaves and moves upward in the plant. Infected leaves turn yellow and eventually fall off; severe cases result in complete defoliation. Black spot is prevalent in wet and warm seasons and is spread by splashing water.

Image 1. Black spot is a common fungal disease. Photo courtesy of Clemson University – USDA Cooperative Extension Slide Series, www.forestryimages.org

To prevent black spot:

- Choose rose varieties that are disease resistant. Note that the black spot fungus has many races, so a plant that is resistant in one geographical area may not be resistant in another.
- Irrigate at ground level and avoid overhead sprinkling. Keep water off leaves as much as possible.
- Prune out crowded and crossing canes to improve air circulation and to facilitate foliage drying.
- Use a preventive fungicide according to the directions on the label. Sometimes alternating between two fungicides prevents the fungus from developing resistance.

Q. — When and how do I prune roses?

A. — The best time to prune roses is in late winter or early spring just before growth begins, typically early March through early April. Pruning needs to be done every year and should be followed by deadheading and clean-up throughout the growing season. There are two exceptions:

- Old heirloom roses and some climbers produce blooms on the previous year's wood, so wait to prune these until after they bloom.
- Diseased plants are often cut back severely in the fall.

Steps in Pruning

- Remove dead, diseased, or damaged canes. Cut stems 1 inch below darkened areas, cutting back to green wood (the center of the stem will be white, not tan). Make the cut at a 45-degree angle, 1/4 inch above an outward facing bud. Remove all canes that are 1/4 inch or smaller in diameter.
- Remove canes that are growing toward the center of the plant, as well as any crossing canes.
- Hybrid teas, grandifloras, and floribundas can be pruned to 12 to 24 inches in height with 9 to 12 large, healthy canes remaining. Old, shrub, and species roses should be pruned lightly, removing no more than a third of the growth.
- Climbing roses are shaped only after they have established long, sturdy canes, usually after two to three years. Select the sturdiest canes as horizontal supports. The shoots from this basic structure, called laterals, will flower. The laterals are pruned back to four or five buds.

Q. — How do I fertilize roses?

A. — Use Table 1 for timing and rates of fertilizer. Availability of soil nutrients, including any fertilizer, depends on the pH of the soil, so it is important to have your soil tested and to adjust the pH as necessary. Roses grow best in the pH range of 5.5 to 7.0.

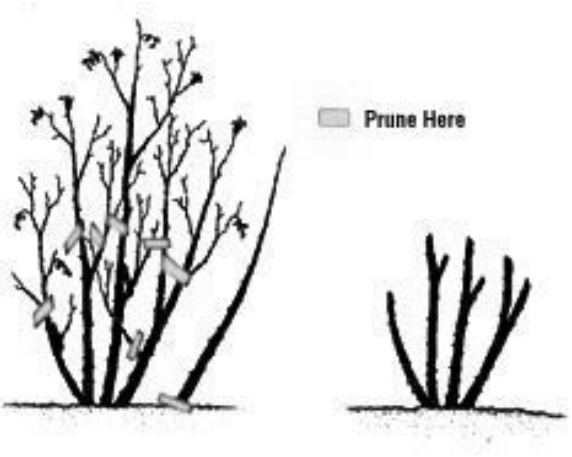


Figure 1. Pruning a hybrid tea rose; before (left) and after (right).

Table 1. Fertilizing Roses.			
Fertilizer Analysis*	**Mid to Late May**	**Mid July**	**Mid to Late October****
	Pounds of fertilizer to apply per 100 square feet		
5-10-5 or 5-10-10	2	2	2
10-10-10 or 10-5-5	1	1	1
12-12-12 or 12-6-6	0.75	0.75	0.75
20-10-10 or 20-5-5 or 20-5-10	0.5	0.5	0.5

* Fertilizer rate is based on nitrogen, the first number in the fertilizer analysis. Any fertilizer with a similar analysis can be used; for example, if a 5-10-10 fertilizer is not available, a 6-12-12 fertilizer would work as well.
** Third application can be made after a killing frost in the fall OR in very early spring before growth begins

Q. — What are some winter hardy roses?

A. — While most roses can survive a typical Ohio winter if they're given the proper care and protection, it helps if you select a rose known to be hardy for your area. Hardiness Zones in Ohio include 5a, 5b, and 6a, ranging from minimum winter temperatures of -15ºF to -5ºF.

Typically, rugosas, other shrub roses, and most miniature roses are quite hardy, although in their first year they may require some protection.

Q. — How do I protect my roses over the winter?

- Discontinue fertilizer in late summer and be sure plants are well watered in late fall.
- After a killing frost but before the soil freezes (late November or early December in Ohio), mound soil or mulch around the plant's crown to a height of 12 inches.
- Prune tall canes back to 30 to 36 inches and tie them together to avoid wind-whipping.

Figure 2. Rose covered with foam cone for winter protection.

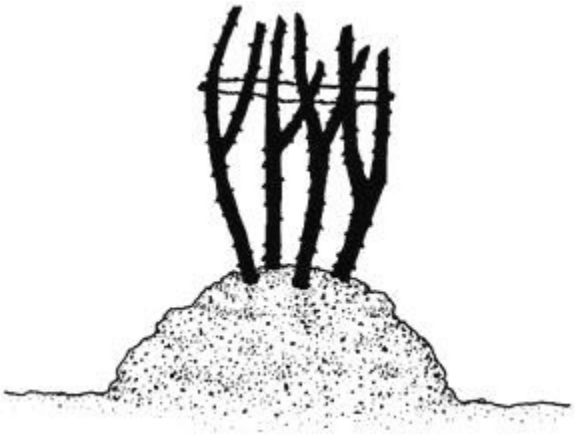


Figure 3. Rose mounded around crown for winter.

- Other, more protective methods, include encircling plants with wire mesh cylinders filled with mulch or leaves, foam rose cones, burlap wrapping, etc.
- Protect climbing roses by removing their supports, laying the canes on the ground (peg them down) and covering with 3 to 4 inches of soil, or tie the tips of canes together and wrap them in straw and burlap.
- In mid-March or early April, remove protective coverings and most of the mulch and soil from around the base of plants.

Q. — Why don't my roses bloom?

- Not enough sun.
- Not enough water. Roses require an inch of water per week during the growing season.
- Too much fertilizer, which causes lots of foliage growth at the expense of flowers, or not enough fertilizer.
- The rose is a recent transplant and still acclimating to the site.
- The particular variety blooms only once a year.
- Improper pruning. Climbers bloom only on old wood, so pruning the plant back each season is a mistake. Also, climbers produce blooms on horizontal canes and may need help in getting shaped and supported.

Q. — What are the site requirements for growing roses?

- At least 6 hours of direct sunlight, though full sun is preferable.
- Avoid planting near trees and shrubs that compete for moisture and nutrients.

Image 2 – Rosa 'Knockout.'

Image 2a – Rosa 'Fuschia Meidiland.'

- An "open" site to allow for air movement around the planting.
- Good water drainage is important; roses will decline if grown in poorly drained soil.

Q. — What are the different types of roses?

A. — The various types of roses are listed in Table 2.

Q. — How do I control Japanese beetles?

- If only a few Japanese beetles are present, handpick and drop them into a jar of soapy water.
- Use an insecticide labeled for Japanese beetles if they are numerous and are causing significant damage.

Image 3. A site with full sun and good air circulation is best for roses.

Image 4. Japanese beetles feeding on roses.

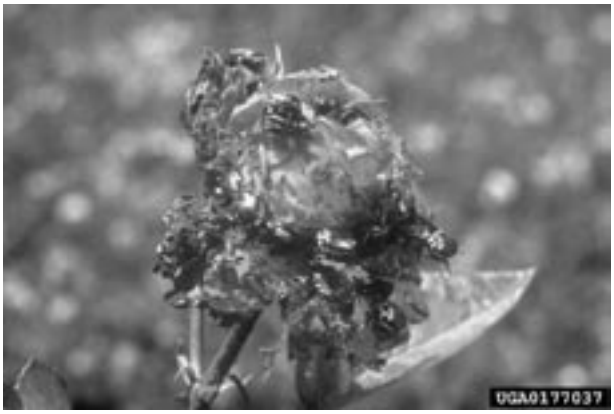


Image 4a. Japanese beetles feeding on roses. Photo courtesy of M. G. Klein, USDA, www.forestryimages.org

- Occasionally, it appears that an insecticide is not working well. Remember that beetles may be flying into your garden where they are active for a while before they succumb to the insecticide.
- Japanese beetle traps may attract more beetles into an area and are not recommended.

Q. — What are some disease-resistant roses?

A. — Floribunda, grandiflora, and shrub roses are generally more disease-resistant than the hybrid teas. Disease-resistance does not mean immunity.

"Resistance" is a local characteristic related to weather conditions/climate and the specific pathogen.

Consult with your garden center professionals, a local rosarian, or a rose society in your area for rose cultivars with good disease resistance. You can also find information on disease-resistant roses on the American Rose Society web site at: www.ars.org

Pictures in this article are from the University of Georgia (UGA) or from OSU Extension photographers.

Table 2. Types of Roses.						
Type	**Form**	**Size**	**Bloom time**	**Fragrance**	**Zones**	**Comment**
Climbers	Vigorous canes; need initial support but eventually sprawl on their own.	6 to 15’	Summer, may repeat into fall.	Some are fragrant.	4-9	Wide range of colors.
Floribunda	Mostly upright-growing shrubs that produce clusters of flowers.	2 to 4’ tall and wide	All season.	Many are fragrant.	4-9	Wide range of colors.
Grandiflora	Tall plants with clusters of flowers on a long stem.	4 to 6’ tall	All season.	Some are fragrant.	5-9	Generally hardy; wide range of colors; good for screening and for cut flowers.
Hybrid Tea	Upright plants; flowers on long, single stems.	3 to 5’ tall; 3 to 4’ wide	Sporadically throughout the season.	Many are fragrant.	4-9	Flowers in all colors except blue; needs ample water and fertilizer.
Miniature	Small plants with leaves and flowers in proportion to their size.	6” to 2’ tall; climbers to 6’	All summer and into fall.	Some are fragrant.	4-9	Wide range of colors; use in containers and as edging.
Polyantha	Mostly compact, rounded plants with clusters of small (1-inch) flowers	18” to 3’ feet tall	Most repeat bloom all season.	Some have light fragrance.	4-10	Withstand heat better than most roses; colors include pinks, reds, orange, yellow, and white.
Rambler	Vigorous, sprawling, long canes.	10 to 20’ tall or more	One bloom between late spring and midsummer.	Many are fragrant.	5-9	Colors include pink, red, yellow, and white; need sturdy supports.
Shrub	Compact or sprawling; single or double flowers.	2-1/2 to 5’ tall or more	Most repeat bloom.	Many are fragrant.	3-10	Wide range of colors; disease-resistant; need minimal maintenance.

~ 6 ~

The Battle of the Borer Continues in Ohio – An Emerald Ash Borer Update

Daniel A. Herms, Amy K. Stone, and Melissa K. Brewer

Introduction

The emerald ash borer (EAB) (Agrilus planipennis) is an exotic, invasive insect that has infested and killed more than 15 million ash trees since its accidental importation from Asia. The core infestation of EAB is firmly established in 20 counties in southeastern Michigan and neighboring Essex County, Ontario, with the leading edge now beginning to spread into Lucas County (the Toledo area), Ohio. Isolated, localized infestations, termed outliers, exist elsewhere in Michigan, Ohio, and northeastern Indiana. EAB has been found in Maryland and Virginia as well.

All major eastern North American ash species (Fraxinus spp.) are susceptible to EAB, which infests trees ranging in size from half-inch caliper nursery stock to fully mature trees in forests. While most native borers colonize only weakened trees, EAB attacks healthy trees as well, making it especially devastating.

An aggressive, coordinated containment and eradication program is currently being undertaken by federal, state, and Canadian agencies. However, if EAB cannot be contained and ultimately eradicated, the impact of EAB on ash in North America will be similar to that of chestnut blight and Dutch elm disease, which devastated both natural and urban forests in the 20th century.

Emerald ash borer was unknown in North America until June 2002, when it was determined to be the cause of unusually widespread ash mortality in southeastern Michigan. This insect is native to areas of Asia, including eastern Siberia, northeastern China, Mongolia, Japan, and Korea, where it occurs on several species of ash. It was probably imported into Michigan at least 10 to 15 years ago by means of infested ash crating or pallets.

Emerald ash borer was first discovered in Ohio, west of Toledo, in February 2003. Since the initial find in Whitehouse, the Ohio Department of Agriculture (ODA) has been battling the borer in hopes of protecting the state's more than 3.8 billion ash trees.

Isolated infestations were subsequently found in 2003, 2004, and 2005 in several counties in northwestern Ohio, including Defiance, Erie, Fulton, Hancock, Henry, Lucas, Paulding, Ottawa, and Williams Counties, as well as in Auglaize, Franklin, and Delaware Counties in central Ohio. Most of these outlier infestations have been linked to artificial spread of EAB

Daniel A. Herms, The Ohio State University, Ohio Agricultural Research and Development Center (OARDC); Amy K. Stone, Ohio State University Extension, Lucas County; and Melissa K. Brewer, Ohio Department of Agriculture, Emerald Ash Borer Program.

from southeastern Michigan through the movement of infested ash nursery stock, logs, and firewood. This largely occurred before EAB was identified, and state and federal quarantines were imposed.

Economic and Ecological Impact

The economic and ecological impacts of emerald ash borer have already been substantial and will be staggering if the infestation continues to spread. Ash species inhabit a variety of soils and ecosystems and are dominant throughout the forests of eastern North America.

According to USDA Forest Service statistics, there are 3.8 billion white ash trees in Ohio, with standing timber valued at more than $1 billion. Furthermore, ash has been one of the most important nursery and landscape species. According to the USDA, the wholesale value of ash sold in Ohio exceeded $2 million in 1998, while a recent survey conservatively estimated the value of the standing ash crop in Ohio to exceed $20 million. This market has been decimated since the discovery of EAB, and many growers are destroying their trees.

Emerald ash borer has already caused hundreds of millions of dollars of damage

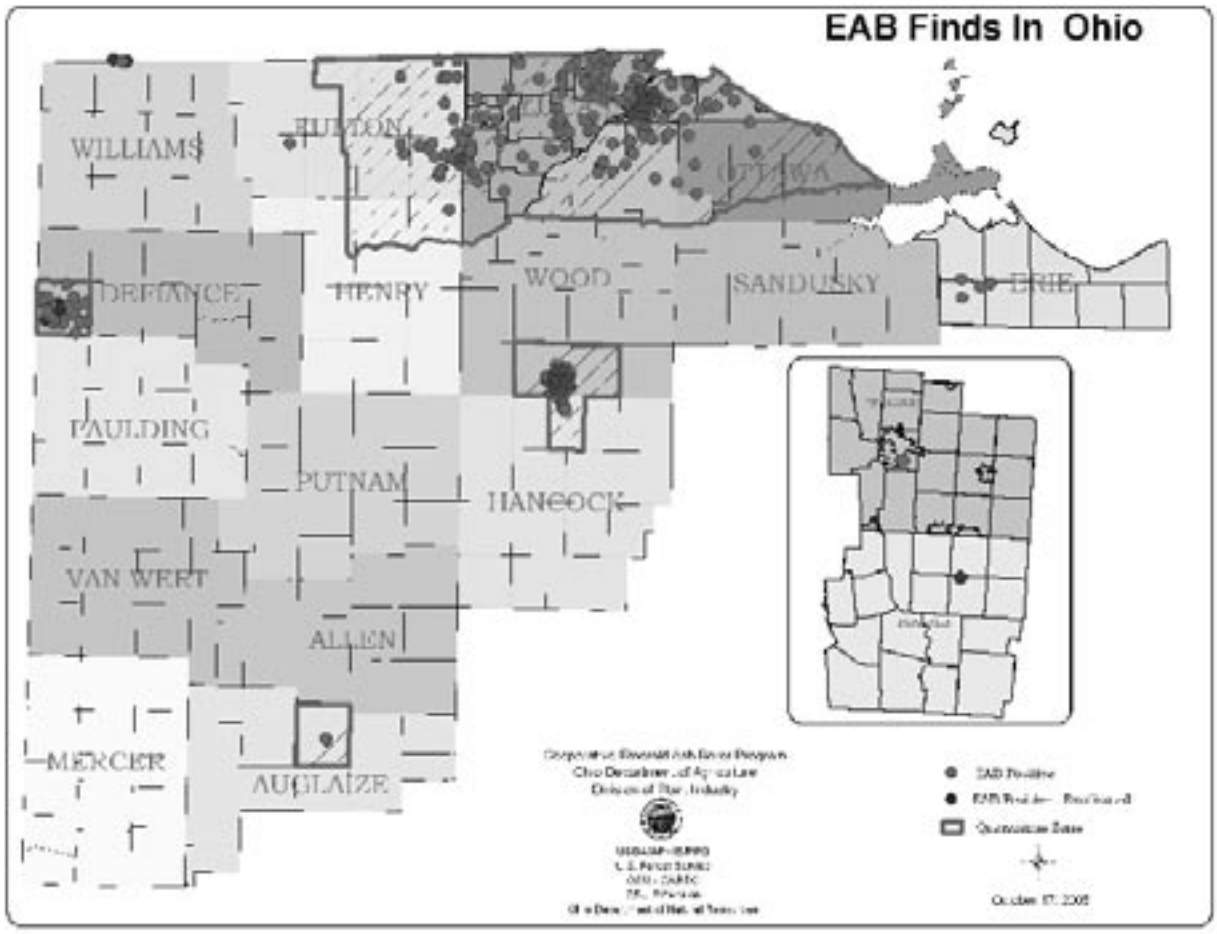


Figure 1. Ohio's EAB Infestation Map, October 18, 2005

to Michigan landscapes, urban forests, and woodlots, and this cost is increasing at an exponential rate. The cost of removing dead and dying ash has overwhelmed municipal budgets in affected Michigan counties. A quarantine on ash timber and all non-coniferous firewood has also had negative economic impacts on sawmills, tool handle factories, and firewood dealers in Michigan and Ohio.

Taxonomy and Biology

Taxonomically, emerald ash borer is a beetle (Coleoptera) belonging to the family known as metallic wood-borers (Buprestidae). Larvae of these beetles are known as flatheaded borers, deriving their common name from the larval stage, which appears to have a broadly flattened head (it is actually the thorax which mostly conceals the much smaller head).

Emerald ash borer larvae are white with a long (about one inch when mature) narrow, segmented abdomen that is also flattened, which gives them the appearance of small tapeworms. Adults are elongate, 1/2-inch-long beetles with striking, metallic green coloration.

Generally, there is one generation each year, although studies by Michigan State University researchers suggest that development may sometimes take two years in newly infested, healthy trees. Adult beetles emerge from infested ash trees in late May through early August, with emergence peaking in mid to late June.

As adults emerge, they leave small (1/8 inch) distinctly D-shaped exit holes in the trunk and main branches. Adults may live three to six weeks and nibble on small patches of ash leaves during this period. Females generally produce about 50 to 80 reddish eggs, which are laid individually

Figure 2. Emerald ash borer adult with D-shaped exit hole.

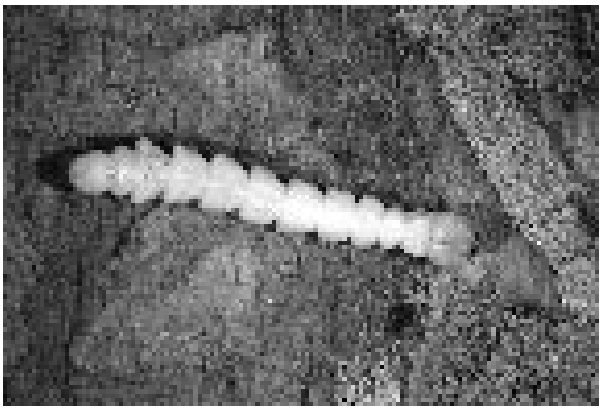


Figure 3. Emerald ash borer larva.

on the bark surface, or within bark cracks and crevices.

When larvae hatch, they tunnel into the tree, where they feed on the phloem and outer sapwood, excavating S-shaped, serpentine galleries just under the bark. These galleries disrupt the flow of nutrients and water between the canopy and roots. This causes canopy thinning and branch dieback, and ultimately tree death. Larvae continue to feed through summer and into the fall. They overwinter in the outer bark or within the outer inch of sapwood. Pupation occurs in mid to late spring. Adults emerge soon thereafter to complete the typical one-year cycle.

Host Plants and Impact

Ash species known to be susceptible include green (Fraxinus pennsylvanica), white (F. americana), black (F. nigra), and blue ash (F. quadrangulata), as well as horticultural cultivars of these species. Only living trees are colonized. This borer will not colonize a dead tree.

In China, EAB colonizes the Asian ash species F. mandshurica (Manchurian ash) and F. chinensis. In Japan, species of Juglans (walnuts and bitternuts), Ulmus (elms), and Pterocarya (wingnuts) have also been recorded as hosts.

However, EAB has not been well studied in Asia (a total of three published pages), and these host records may reflect the existence of subspecies or simply taxonomic confusion.

Furthermore, host records for borers are notoriously unreliable and often include tree species from which adults were collected, even when the larvae are not able to develop on those species. Research on host range and host preference is underway, and preliminary results from Michigan State University studies strongly suggest that walnut and elm will not be viable hosts for EAB in North America.

Studies are also underway to investigate the susceptibility of plants related to ash, such as lilacs and privet. To date, these species have not been observed to be infested, even when growing in close proximity to infested ash trees.

Diagnosing Emerald Ash Borer: Signs and Symptoms

Infestations of EAB are usually difficult to detect until they become severe. Larvae are hidden under bark, and adults may spend most of their time in the upper tree canopy. Research indicates that EAB usually colonizes the upper trunk area of large trees first, which makes it difficult to see any diagnostic signs or symptoms. In addition, symptoms of an EAB infestation resemble other causes of tree decline.

Symptoms that are usually associated with an EAB infestation include small, vertical splits in the bark that can sometimes be observed on large branches or on the trunk. These splits occur when callus tissue that forms around a larval gallery pushes the outer bark away from the sapwood. To confirm the presence of EAB, one can widen the splits to reveal larvae and galleries under the bark. Usually, larval galleries are distinctly S-shaped or serpentine and are packed tightly with frass (mixture of sawdust and excrement). They are also visible on the inner surface of the outer bark when it is removed.

The presence of small, distinctly D-shaped exit holes in the trunk or scaffold branches is a good sign of infestation. As infestations progress, the canopy starts to thin, and branch dieback may occur. Tree decline often accelerates rapidly at this point.

When EAB populations are high, trees typically die within two to four years of infestation. Epicormic shoots often sprout from the main trunk of declining trees, and root sprouts sometimes occur at the base of dying trees. Woodpeckers are proving to be important predators of EAB. A noticeable increase in woodpecker activity on ash trees can provide an early indication of an infestation, especially during winter months.

The Plan to Eradicate Emerald Ash Borer: The Cooperative EAB Project

USDA-APHIS (Animal and Plant Health Inspection Service), the USDA Forest

Service, and the Canadian Food Inspection Agency (CFIA), in cooperation with state departments of agriculture and natural resources, have joined forces to implement a long-term program with the objective of containing and eventually eradicating EAB from North America.

The plan, which is in the early stages of implementation, is to:

- Locate and promptly eradicate outlier infestations.
- Prevent establishment of new outlier infestations through aggressive enforcement of state and federal quarantines.
- Contain, suppress, and ultimately eradicate the core infestation in the Lower Peninsula of Michigan.

A key component of the eradication plan is an intensive monitoring program to evaluate the success of outlier eradication efforts; identify existing, low-density infestations that have so far escaped detection; and quickly detect new infestations.

Eradicating Outlier Infestations

Rapid elimination of outlier infestations before they expand and become entrenched is critical. To date, several outlier eradication programs have been implemented in Michigan, Ohio, Maryland, and Virginia. The eradication efforts in Ohio have resulted in the destruction of more than 200,000 ash trees, mostly small saplings, in 2005, and a total of 250,000 ash trees since 2003.

Eradication of outlier infestations involves removal of all ash trees, visibly infested or not, within a half-mile radius of the visibly infested trees. Since infested trees do not show external signs or symptoms of attack during the first year, there is no way to determine which trees in the vicinity of infested trees are themselves infested.

Consequently, it is necessary to cut even apparently healthy trees to destroy the insects lurking within before they can emerge, disperse, and reproduce. Felled trees are chipped and incinerated at a co-generation power plant, and stumps are treated with herbicide to prevent sprouting.

Using Science in the Fight

Three major studies of outlier infestations conducted in 2003 and 2004 by Michigan State University researchers and cooperators provide a science-based rationale for the current eradication strategy. This research involved felling and peeling bark from a large number of ash trees of all sizes occurring within a half-mile of a known point source — e.g., the infested firewood or nursery trees from which the infestation was known to originate.

Intensive sampling showed that 80 percent of all larvae were in trees within 100 yards of the original point source. At one site, infested trees were found as far as 750 meters (nearly 0.50 miles) from the point source. But at the other two sites, all larvae were found within 0.38 miles of the point source.

Therefore, the cutting of all ash trees within a half-mile radius of a known infested tree should eliminate the infestation. Treating infested trees with insecticides as an alternative to destroying them is not a viable option for eradication sites. While research has shown that preventive insecticide applications can effectively protect shade trees from emerald ash borer in the core infestation in southeastern Michigan, no insecticide program has been effective enough for eradication purposes.

Using Detection Trees

To ensure success, these outlier eradication sites are being monitored for at least three years after cutting to determine if there is a need to mop-up any borers that may have slipped the dragnet. Monitoring, however, has proved difficult as research indicates that EAB does not produce the long-range pheromones useful in trapping other insect pests such as gypsy moth.

Rather, monitoring is currently being conducted in Michigan, Ohio, and Indiana by means of an extensive grid of several thousand girdled detection trees. Research conducted by Michigan State University and the U.S. Department of Agriculture's Forest Service scientists over the last several years showed that adult beetles are more strongly attracted to girdled trees than to unwounded trees, possibly due to host plant volatiles released into the air by the girdled trees. Detection trees, which are girdled in the spring, are cut in the fall and debarked to detect any larvae that may be present.

Creating the Containment Zone

There are so many infested trees in the core infestation zone in southeastern Michigan that it is physically and economically impossible to remove them all. Rather, regulatory officials have adopted a strategy to contain the core infestation on the Lower Peninsula of Michigan where it is largely surrounded by water.

The strategy is to prevent EAB from crossing key gateways through which EAB could spread to the rest of North America, including the Straits of Mackinac to the north, the St. Clair River to the east, and Michigan's southern border with Ohio and Indiana.

An intensive monitoring program is designed to detect infestations in these gateway zones while they are small and most easily eradicated. Over time, these eradication sites will coalesce to form an EAB containment zone, in which reduced density of ash will provide a barrier to EAB dispersal.

EAB Populations Decline as Hosts Are Eliminated

Mortality of ash in both natural and urban forests is rapidly approaching 100 percent where EAB has been established the longest, and EAB populations are starting to decline as its hosts are eliminated. This suggests that EAB may not permanently colonize infested areas as gypsy moth has, but rather may be subject to local extinction as its host trees die, similar to the effect of chestnut blight on American chestnut. Eradication is possible if the core burns itself out faster than the leading edge spreads.

The key to success will be development and implementation of suppression measures that slow the rate at which EAB spreads. There is much less forest cover in the farm country of northwestern Ohio than there is in southeastern Michigan, and it is hoped that this will provide a strategic advantage to efforts to slow the spread of EAB in Ohio.

Preemptive Harvest

The intensive monitoring program within and beyond the periphery of the gateway zones is designed to rapidly detect the spot infestations that will inevitably breach the containment zone so that they can be quickly extinguished. It is important to realize that all of the ash trees in gateway areas inevitably will be killed by EAB, as will billions more, if EAB is allowed to spread unchecked across North

America. Property owners in the vicinity of gateways, including northwestern Ohio, are encouraged to preemptively harvest their ash trees now, which will contribute to the overall goal of reducing ash density while allowing property owners to extract economic value from their ash trees while they still can.

Preventing the artificial spread of EAB is another major component of the eradication plan. Accordingly, federal, state, and Canadian quarantines have been enacted to prohibit movement of all non-coniferous firewood, ash nursery stock, logs, wood chips, and untreated lumber. Arborists and other green industry professionals working in northwestern Ohio need to be familiar with and understand these regulations.

Preventing the movement of firewood presents a particularly tough challenge, and a multi-state publicity campaign has been launched to inform people about the firewood quarantine. Highway signs warn motorists of substantial fines for moving firewood outside the quarantine zone. Regulatory and law-enforcement officials have established periodic check-points at the Ohio-Michigan border as well as at the edges of regulated areas to intercept firewood. A stepped-up inspection and enforcement program has resulted in several prosecutions.

Figure 2 is a map of the current quarantined areas in Ohio. Regulated areas have been expanded as new infestations have been detected. It is important to continually stay updated

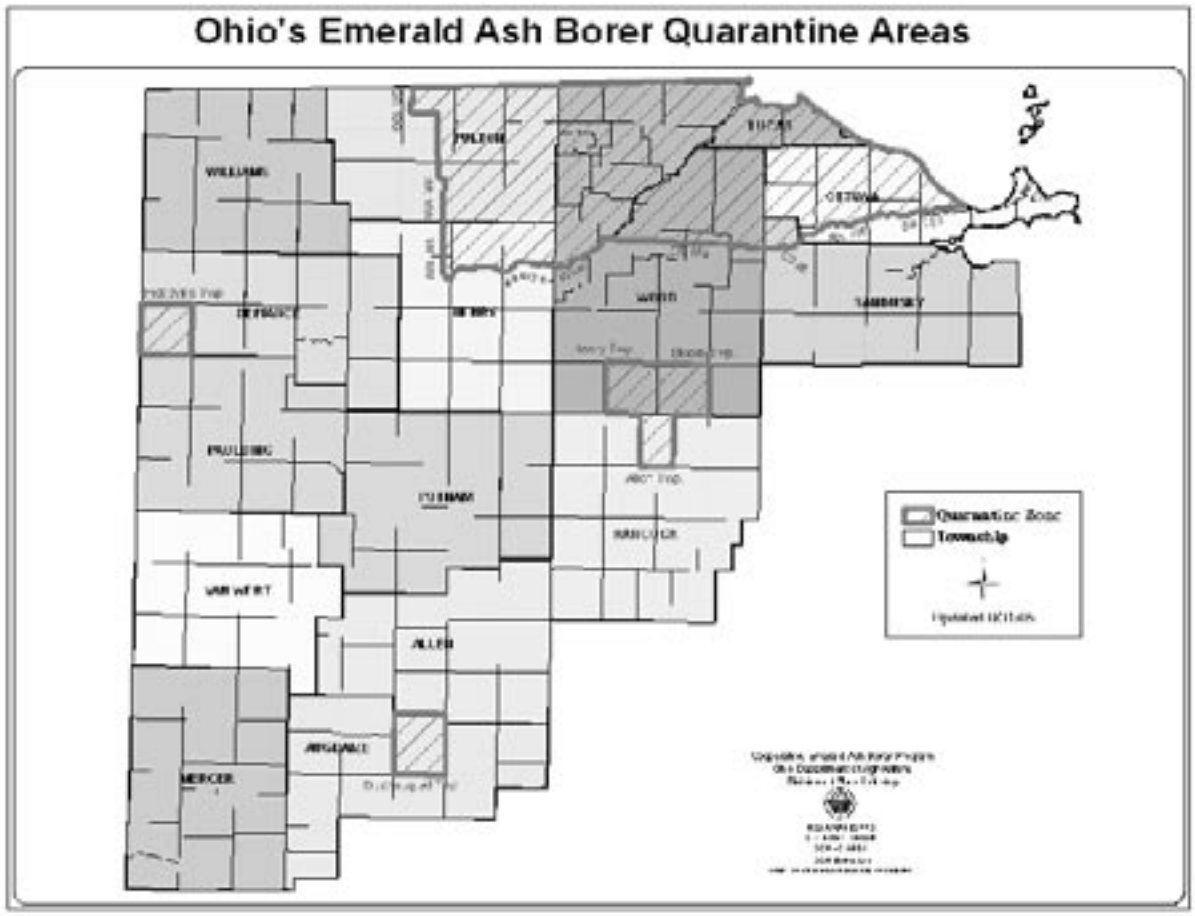


Figure 2. Ohio's EAB Quarantine Map, September 30, 2005

on any changes the ODA makes to the regulated area. Maps can be viewed, downloaded, and printed from the ODA web site at: http://ohioagriculture.gov/eab/

Should I Treat My Tree for Emerald Ash Borer?

Ohio State Extension personnel have received many questions from homeowners and green industry professionals wondering if preventive insecticide applications are necessary in Ohio to protect ash trees from emerald ash borer. Members of the OSU Extension Nursery, Landscape, and Turf Team, in consultation with Ohio Department of Agriculture officials, have developed the following recommendation:

"Currently, we recommend that ash trees in Ohio not be treated with insecticides for emerald ash borer, even if the tree is in the immediate vicinity of a known infestation."

First, it is important to maintain perspective on the problem. The vast majority of ash trees in Ohio are not currently at risk. There has been aggressive marketing of emerald ash borer insecticide treatments, but given the current status of the infestation, these programs are not warranted and cannot be justified.

We do not even recommend insecticide treatments for trees in the immediate vicinity of known infestations, as this also would be a waste of money. The logic behind this recommendation, which may seem counter-intuitive, is based on the interaction between the biology of the insect and regulatory issues associated with the program to eradicate emerald ash borer from North America. The situation is different in the core infestation quarantined counties in Michigan (for reasons to be discussed), where many property owners are choosing to protect their trees with insecticides.

Emerald ash borer is an exotic insect that is currently regulated by USDA-APHIS and the ODA and is subject to eradication. Hence, if an infested tree is discovered in Ohio, it will have to be removed and destroyed. Female emerald ash borers are highly mobile and lay eggs on many trees. Infested trees do not show any external symptoms during the first year of the infestation. Therefore, in the vicinity of any tree showing visible signs of infestation, there will be many more trees that are infested but with no external symptoms (asymptomatic carriers).

Since there is no way to tell if these trees are infested, all trees in the vicinity of the infested tree will have to be removed and destroyed, as per eradication protocols, before larvae mature and adults can emerge, even if the trees appear healthy. This will be true even if that tree has been treated previously with insecticide, as research has shown that even the best treatments provide substantially less than 100 percent control of EAB on large caliper trees. Therefore, a previous history of insecticide treatment will not spare a tree from the eradication program, even if that treatment history is well documented.

What About Trees in the Immediate Vicinity of Known Infestations?

People near an eradication zone may be tempted to treat their trees as insurance in case an EAB escaped the eradication program. However, even if a borer did escape, it is extremely unlikely that it will lay eggs only on trees that have been treated with insecticides, as borers lay

many eggs as they move from tree to tree. If an EAB does lay eggs even on one untreated tree in the same neighborhood as the treated tree — and there are many ash trees along fence rows, ditches, and in woodlots — eventually the untreated tree will show signs or symptoms of infestation and will have to be destroyed. In this case, all trees in the vicinity of the infested tree will also have to be destroyed, even if they have been previously treated.

In the core infestation in southeastern Michigan, the situation is different. Because there are too many infested trees to cut down as part of the eradication program (discussed earlier), and because property owners there are financially responsible for removal of dead trees on their property, many people in the core infestation zone are taking steps to protect their ash trees, including making preventive insecticide applications.

In Closing

Emerald ash borer has the potential to decimate ash throughout North America, but efforts to eradicate this invasive pest are now underway. Eradication is possible but will require considerable resources and political will.

Even if these efforts are not successful, as some critics suggest, the EAB Cooperative Management Program will dramatically slow the spread of the infestation, buying time needed for research advances on effective traps, biological controls, host plant resistance, and other strategies. The eradication program will require a long-term commitment of funds and effort. But these costs will be miniscule compared to the devastating economic and ecological impacts of EAB if it is allowed to spread unchecked throughout North America.

For additional and the most updated information on the emerald ash borer, check out these web sites:

Ohio State University Extension
http://ashalert.osu.edu

Ohio Department of Agriculture
http://www.ohioagriculture.gov/eab/

Ohio Department of Natural Resources
http://www.dnr.ohio.gov/forestry/eab/default.htm

Tri-State Emerald Ash Borer
http://emeraldashborer.info

Contact information for the Ohio Department of Agriculture's Emerald Ash Borer Program is as follows:

EAB Hotline — 888-OHIO-EAB
Ohio Department of Agriculture
Plant Industry Division
Emerald Ash Borer
8995 East Main Street
Reynoldsburg, OH 43068-3399
E-mail — eab@mail.agri.state.oh.us

,,,

~ 7 ~

Giant Hogweed: A Hazarous Invasive Weed in Ohio

David J. Goerig and David L. Marrison

Giant Hogweed from Pierpont, Ohio, in Ashtabula County. Photo courtesy of David Marrison, OSU Extension.

Introduction

The state of Ohio recently added Heracleum mantegazzianum, better known as giant hogweed, to the state noxious weed list. Giant hogweed is also on the federal noxious weed list, making the propagation, sale, or transportation of this weed unlawful. Giant hogweed has been included on these lists because of its ability to spread and its potential hazard to human health.

Giant hogweed is native to the Caucasus region of Eurasia and was introduced into Europe in the 1800s. It has been found in Australia, Austria, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, the former Soviet Union, Sweden, Switzerland, and the United Kingdom.

Giant hogweed was first recorded in the United States in 1917 in an ornamental garden in New York. This weed has also been cultivated for its fruit, which is used as a spice (golmar) in Iranian cooking. To date, giant hogweed has been recorded in the states of Connecticut, Maine, Maryland, Massachusetts, Michigan, New York, Ohio, Oregon, Pennsylvania, and Washington.

One giant hogweed plant can produce 20,000 seeds, thus allowing it to spread easily when not managed. This plant, once found exclusively in ornamental gardens, has escaped and has become established in rich, moist soils along roadside ditches, stream banks, vacant farmland, and tree lines. Giant hogweed plants form a dense canopy and will out-compete and displace many native species.

Giant hogweed's greatest danger, however, is the effect its sap has on humans. Furocoumarins in the sap can cause a skin reaction known as photodermatitis. This causes the skin to be highly sensitive to ultraviolet light. Swelling and blistering of the skin may occur

David J. Goerig, Ohio State University Extension, Mahoning County; and David L. Marrison, Ohio State University Extension

The sap of giant hogweed can cause severe burns on the skin. Photo courtesy of USDA-APHIS.

Giant Hogweed can grow up to 15 feet in height and flowers in late June to early July. Photo courtesy of David Marrison, OSU Extension.

which can result in permanent scarring. Contact with the eyes can cause temporary or sometimes, permanent blindness.

Ohio's population of giant hogweed is primarily found in northeastern Ohio, especially the counties that border the state of Pennsylvania. Ashtabula County, which borders Erie County, Pennsylvania (which has more than 100 confirmed sites of giant hogweed), has reported the highest number of hogweed sites to date.

Identification

Heracleum mantegazzianum is an herbaceous dicotyledon plant that is a true biennial. It is a member of the Apiaceae (Umbelliferae) family of plants, commonly known as the carrot or parsley family. Despite being labeled a biennial, giant hogweed appears at times to give rise to new plants from the branched taproot it develops; however, it does not reproduce vegetatively. It can live for several years, but once it flowers and bears fruit, it dies. Giant hogweed is hardy to Zone 3. It prefers full sun and moist, well-drained soil but will dominate space in any site in which it is planted.

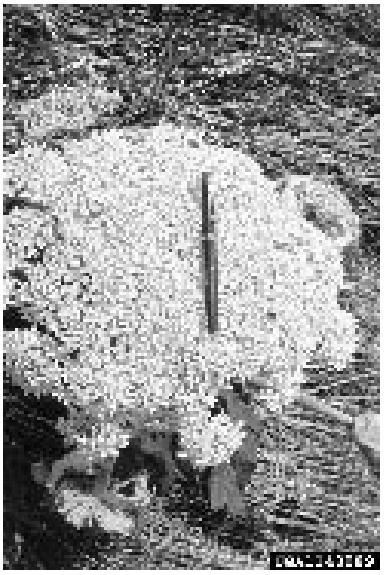
Giant hogweed is a prolific seed (fruit) producer and propagates itself exclusively each year in this way. The fruit can be described as a dry, flattened, oval, two-winged mericarp, approximately 3/8 inches long, containing one seed.

Seeds are an earth-tone tan color with brown lines running vertically away from their withered flower petals. An average plant bears approximately 20,000 seeds. Current year seed of H. mantegazzianum is dormant and does not germinate in the fall. Dormancy of these seeds is overcome by cold and wet weather conditions that occur during normal winters.

Seeds produced by giant hogweed are said to remain viable in the soil for many years, although no formal study has been conducted to support that claim. It is known, though, that all it takes is for one seed to germinate in an area to give rise to a new infestation.

Seed in the field is not easily disbursed by animals, although it is possible. Water and wind can move seed from its source, especially in flood plains and during winter storms. The most efficient seed dispersal is known to be through human activity. Giant hogweed seed heads have been used in dried flower arrangements and other decorations.

Giant hogweed seeds. Photo courtesy of David Marrison, OSU Extension.



A cut umbel from giant hogweed. Photo courtesy of the USDA-APHIS.

Terminal umbel of giant hogweed. Photo courtesy of David Marrison, OSU Extension.

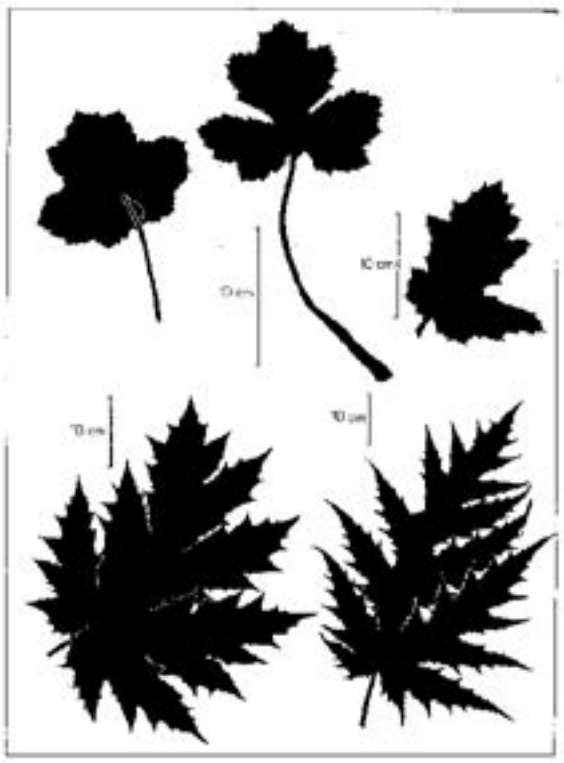
The inflorescence on giant hogweed is a distinct set of thousands of tiny, white flowers, arranged together in compound umbels. Together, they appear flat topped and give the impression of looking at white umbrellas. Giant hogweed flowers in late June to early July, and inflorescences can grow to a size of 2-1/2 feet in diameter.

This plant remains in the rosette stage until it develops sufficient root reserves to bloom. In moist, fertile soil this happens in the third to fifth season of its life.

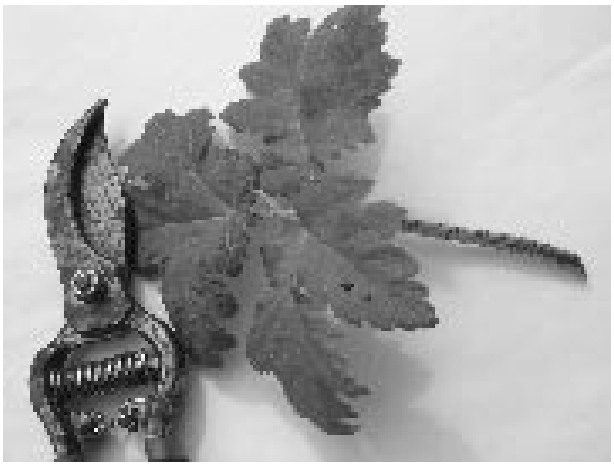
This plant has been a somewhat popular ornamental plant in Europe, and now in the United States, because of its massive size and eye appeal. It is easily distinguishable from many look-a-likes as it can grow to a height of 15 feet.

Giant hogweed foliage along the base of the plant is ternately compound and unfolds in the early summer into deeply incised, lobed leaves measuring up to 5 feet in width. The leaflets attached higher on the stem are not as large; they are triangular-lanceolate and also are deeply cut. Leaves are arranged randomly on the stem of the plant.

The stem of giant hogweed is coarse and ridged with protruding white hairs that are more noticeable at the base of the leaf stalks. Stem color is mostly green with purple blotches that contrast easily with the white hairs. Giant hogweed stems grow to a height of 10 to 15 feet and can measure between 2 to 4 inches in diameter. This herbaceous plant's stem is hollow.



Variable leaves of giant hogweed. Cotyledon or seed leaf shape (top, left). Juvenile leaf shape (top, center and right). Typical spring and summer leaf shape (bottom, left). Fall leaf shape (bottom, right). Photo reprinted with permission from Dr. Jörg Ochsmann, Germany.



A young giant hogweed seedling. Photo courtesy of David Marrison, OSU Extension.

Giant Hogweed leaves develop into deeply incised, lobed leaves measuring up to 5 feet in width. Photo courtesy of David Marrison, OSU Extension.

Heracleum lanatum

Plants belonging to the parsley family share the same growth characteristics, which is why giant hogweed is commonly confused with other plants each year. Heracleum lanatum, or cow parsnip, a native plant, is one of the plants most likely to be confused with giant hogweed. Cow parsnip is smaller and very seldom reaches a height above 8 feet. Mature leaves of H. lanatum seldom grow beyond 2 to 2-1/2 feet in size. Although the bloom is similar to hogweed, it never reaches the magnitude of H. mantegazzianum, and the plant typically blooms a few weeks earlier.

Angelica atropurpurea

Angelica is another plant mistaken for giant hogweed. Angelica is shorter, normally only growing to 8 feet in height. Its flowers are small, white, and arranged on compound umbels that appear globular, not flat-topped like hogweed, and not much bigger than 6 inches in diameter. Stems are green or purple, hollow, and appear waxy, not coarse. The foliage differs in that it is biternately compound, not ternately compound.

Prominent white hairs circle stem junctions of the giant hogweed. Photo courtesy of David Marrison, OSU Extension.

A broken stem can expose humans to the harmful sap of the giant hogweed. Photo courtesy of David Marrison, OSU Extension.

An older giant hogweed stem late in the growing season. Photo courtesy of David Marrison, OSU Extension.

Conium maculatum

Poison hemlock is a common biennial in Ohio that grows from 4 to 9 feet tall. The stem is waxy and green with purple blotches. It is confused with H. mantegazzianum because the stems appear to look like it, but closer inspection reveals they are smooth and absent of the white hairs. Additionally, poison hemlock's flower clusters, even though they are white, are less densely arranged on the stem, giving them an overall smaller appearance. C. maculatum foliage looks more fern-like as its leaves are twice or three times pinnately compound.

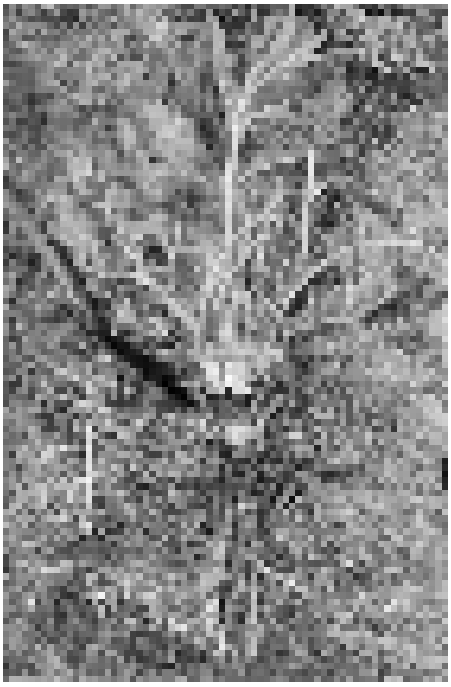
Control

Control of giant hogweed usually involves such practices as digging, mowing, cutting, removal of umbels, grazing, and herbicide application. The control strategies selected will be dependent on the area covered by the plant, accessibility, and plant density. Because giant hogweed is a prolific seed producer, continuous management to prevent regeneration is important. Most research indicates that five years of intensive control is required.

Regardless of the method selected, protective water-resistant clothing and eyewear should be worn when working around this plant, especially when cutting, as the risk of splashing the toxic sap on the skin will be the greatest.

Manual Control

Manual control of giant hogweed can be accomplished by root cutting, mowing, and umbel removal. Root cutting involves



The root structure of giant hogweed. Photo reprinted with permission from Mads A. Sorensen, Denmark.

using a shovel to cut the deep tap root of the plant. It is recommended to dig and cut the root 4 to 6 inches below the soil line. This control method is partially effective and labor intensive. Monitoring of the area should continue for regenerated plants. Care must be exercised because of the sap in the stems.

Mechanical mowing using a mower or a scythe can also be a good control method but will need to be undertaken multiple times during the growing season. This will hinder re-sprouting plants from growing and storing reserves in their root systems. If accessibility to plants is limited, flowering plants could be cut once during mid-flowering.

An innovative European developed a special Hogweed Tool consisting of a curved saw blade on a long handle. This allows a safety zone for the person eradicating the hogweed. It is not recommended that a weed-eater be used to cut giant hogweed because of the splattering of the hogweed sap.

Removal of the flower umbels can also be utilized as part of a control program. Timing of the removal of umbels is critical. It is most effective to remove the umbels when the terminal umbels begin to flower. If cutting is performed too early, then rapid regeneration will occur and often with increased seed production. Cutting too late will increase the likelihood that seeds may be lost to the seed bank. The practice of cutting umbels is recommended as a supplement to other control practices.

Use Extreme Caution

Gardeners, landscapers, and nursery workers should exercise caution around this plant. As was mentioned previously, the plant juices can cause phytophotodermatitis to the skin. If the plant sap comes in contact with the skin in the presence of sunlight, a severe rash and/or blistering can occur. Extreme caution should be taken when eradicating this plant. Warn others standing at the site to keep a clear distance from brush cutting mowers. Launder all work clothes separately from other clothing.

Grazing

Europeans also have used sheep or beef cattle to control large stands of young hogweed vegetation. Over time, grazing depletes the energy reserves of plants, thus leading to eradication. Best control is obtained when grazing begins early in the season when the plants are small. It should be noted that hogweed can cause inflammation of the skin, lip, and nostrils of the grazing animal. Livestock with dark pigmentation of the skin, like black-faced sheep, are recommended for grazing to help reduce potential inflammation

Sheep have been used in Europe to graze large populations of giant hogweed. Photo reprinted with permission from Charlotte Nielsen, Forest & Landscape Denmark.

A giant hogweed plant after a chemical application of glyphosate. Photo courtesy of David Marrison, OSU Extension.

problems. If problems occur, the sheep or cattle should be removed from the grazing site.

Chemical Control

Chemical control is the most common control strategy tool utilized. Numerous research trials in Europe and the United States have demonstrated that giant hogweed can be effectively eradicated using chemicals; however, multiple applications are generally necessary.

Glyphosate and triclopyr have both been shown to be effective due to their systemic control. Glyphosate should be used cautiously around desirable species as it is non-selective. Other products such as 2,4-D, TBA, MCPA, and Dicamba will control giant hogweed above the ground but are relatively ineffective at killing the root system.

It is recommended that chemical sprays be used in early spring when the hogweed plants are approximately 8 to 20 inches tall with a follow-up spray in late July or August. Any bare areas should be seeded with appropriate native vegetation to reduce the probability of a re-infestation of hogweed. It is important to use chemicals in accordance with the directions on the label.

Final Note: Obviously, giant hogweed should never, ever be planted in the garden or landscape.

Other Information Links

It is recommended that landowners who find giant hogweed on their property contact their Ohio State University Extension county office or a regional USDA-APHIS office for current spray recommendations or to determine the status of any governmental spray program being conducted.

References

Neilson, C., Ravn, P., Nentwig, W., and Wade, M. 2005. The Giant Hogweed Best Practice Manual. Horsholm, Denmark: Forest & Landscape Denmark. On-line. Retrieved August 2005. www.giant-alien.dk

United States Department of Agriculture, Animal and Plant Health Inspection

Service. 2002. Giant Hogweed. Online. Retrieved August 2005. http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fs_phhgweed.pdf

Mayer, L. (n.d.) Comparison of Management Techniques for Heracleum mantegazzianum, North and Central Europe. On-line. Retrieved August 2005. http://horticulture.coafes.umn.edu/vd/h5015/00papers/mayer.htm

King County Washington. 2004. Best Management Practices for Giant Hogweed. On-line. Retrieved August 2005. http://dnr.metrokc.gov/wlr/LANDS/Weeds/pdf/hogweed-control.pdf

Pennsylvania Department of Agriculture. (n.d.) Giant Hogweed — Heracleum mantegazzianum. Online. Retrieved July 2004. http://www.agriculture.state.pa.us/agriculture/lib/agriculture/plantindustryfiles/hogweed11-17.pdf

”””

~ 8 ~

Ohio State University Extension Gateway Learning Gardens 2005 Herbaceous Ornamental Field Trial Results

Pamela J. Bennett

Introduction

Clark County Extension Master Gardener volunteers have evaluated annuals at the Ohio State University Extension Clark County office site in Springfield, Ohio, since 1995. Carolyn Allen and Barbara Brown are Master Gardener volunteer co-chairs of the project. The field trial plots are located in the Gateway Learning Gardens and are planted and maintained by volunteers. Approximately 40 volunteers work on this project, from starting plugs and seeds in the greenhouse to planting and weeding the plots.

The plots are typical of the west-central Ohio area; the soil is predominantly clay with a pH of 7.3. The current plots were established in the fall of 1996. The beds were tilled to a depth of 14", and 2" of compost was added. Compost was added when new beds were established; additional compost is added every three years. Compost was last added to all beds in the fall of 2002. There is approximately 5,000 square feet of bed space in full sun and approximately 1,000 square feet in shade.

Pamela J. Bennett, Ohio State University Extension, Horticulture, Clark County.

The selection of plants to be trialed in the garden varies from year to year. Selection is based on entries from seed companies, performance in prior years, current trends, and industry recommendations. Data presented in this report reflect the growing conditions of 2005. The purpose of the evaluation is to provide growers, landscapers, and homeowners a guide for plant selection for Ohio.

Methods

The plants were started from seeds, plugs, or cuttings, depending on the species, according to the recommended starting dates. They were planted in the plots on May 19, 2005. There were six plants of each variety in a row with each plant spaced 1.5' apart; rows were spaced 2' apart. Trailing or vining plants were spaced 2' apart with 4' between rows. Osmocote™ (14-14-14) fertilizer was incorporated into the soil prior to planting at the labeled rate. Beds were hand weeded as needed throughout the season.

Irrigation was applied during dry periods so that plants received at least 1" of water per week. (See the section on Weather Information for details.) No additional applications of fertilizer were made. The plants were not deadheaded or

pruned during the growing season. No insecticides or fungicides were applied. No mulch was used; volunteers weeded the plots as needed. Plants were grown in full sun, unless otherwise indicated. (Note, the plants in bold type in the list were those in the shade house). The material for the shade house provided 70% shade.

Three people conducted visual evaluations in June, July, August, and September. The entire row was given a visual rating from 1 to 5. If there were less than 3 plants remaining in one row at any time during the evaluation, the variety was dropped from the trials, and the result is listed as "dead." A rating of 5 was considered to be excellent, and a rating of 1 was considered to be poor. The three individual evaluation ratings were averaged for the monthly rating figure. The monthly evaluations (June-September) were averaged for the overall rating for each variety.

Weather Information

Precipitation and temperatures for May were below average. The annuals were planted under good soil conditions; plants were irrigated in the first weeks in order to establish a good root system. Annuals were slow to take off in May due to cooler temperatures. Temperatures were above normal in June, July, August, and September. In 2005, there was a total of 26 days over 90ºF compared to 0 days in 2004, 3 days in 2003, and 30 days in 2002.

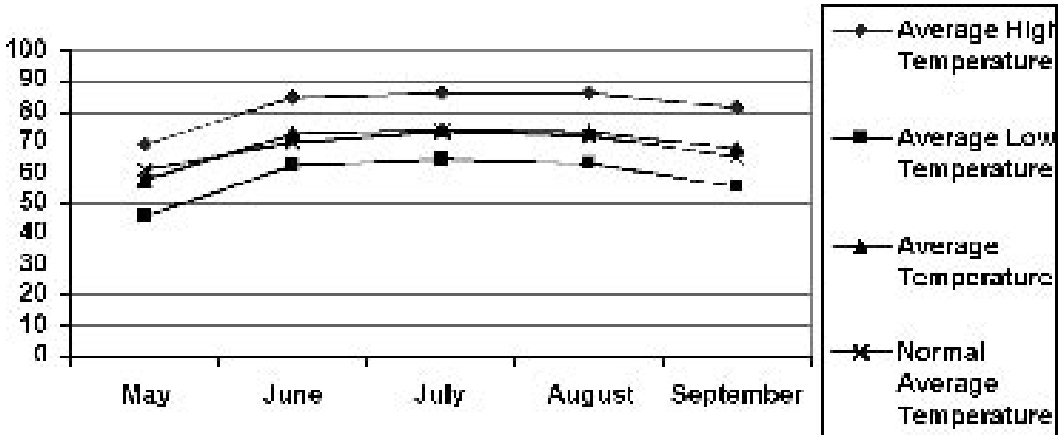
This growing season was drier than normal. Supplemental irrigation was necessary in order to provide 1" of water per week; it was used the entire season. Weather conditions for this growing season as well as normal average temperatures and precipitation are shown in Table 1.

Results

Table 2 lists the varieties in the 2005 field trials and their monthly ratings and overall rating. They are in order of highest to lowest overall rating. The plants listed in BOLD are those varieties that were grown under the shade structure (70% shade cloth).

The supplier for each variety is listed in the table; the supplier key is at the end of the text. The plants are listed in order of Overall Rating from highest to lowest. A rating of 5 is the highest; a rating of 1 is the lowest.

Table 1. Weather Conditions for the 2005 Growing Season, Clark County.					
Temperature	**May**	**June**	**July**	**August**	**September**
2005 average high temperature Fº	69.7	84.9	85.9	86.1	81.4
2005 average low temperature Fº	45.9	62.5	64.5	62.9	55.9
2005 average temperature Fº	57.9	73	74.5	73.6	67.9
Normal average temperature Fº	61.3	70.3	73.8	72	65.2
Precipitation					
Normal average rainfall (inches)	4.58	4.16	4.08	3.5	2.99
2005 rainfall (inches)	2.25	2.73	1.55	3.38	3.15
Days over 90ºF	0	9	5	12	0



Acknowledgment

Ohio State University Extension and Master Gardeners of Clark County would like to thank the following for their support: Clark County Engineers, Springfield Township, Clark County Fairgrounds staff, Clark County Commissioners, National Trails Parks and Recreation District, and the following companies who participated in the trials.

Suppliers

BS – BallSeed® Company
http://www.ballseed.com/

JP – Jackson & Perkins Wholesale
http://www.surfinia.com/

Keift Seeds
http://www.kieftseeds.com/

PAS – PanAmerican Seed®
http://www.panamseed.com/

Proven Winners® - PW
http://www.provenwinners.com/

S – Sahin
http://www.sahin.nl/

SAK - Sakata® Seed Corporation
http://www.sakata.com/

Table 2. Clark County 2005 Field Trial Ratings.

Plant Name	Series	Cultivar	Source	June	July	Aug	Sept	Overall Rating
Petunia	Supertunia®	'Vista Bubblegum'	PW	5.00	5.00	5.00	5.00	5.00
Ageratum	Artist™	'Alto Blue'	PW	5.00	5.00	4.67	5.00	4.92
Euphorbia		'Diamond Frost'	PW	4.67	5.00	5.00	5.00	4.92
Ornamental Millet		'Jester'	PAS	4.67	5.00	5.00	5.00	4.92
Ocimum basilicum		Experimental basil	S	4.67	5.00	5.00	5.00	4.92
Gaura	Stratosphere	'White'	PW	4.67	5.00	5.00	5.00	4.92
Nemesia		'Compact Pink Innocence'	PW	5.00	5.00	4.67	4.67	4.83
Petunia	Supertunia®	'Vista Fuchsia'	PW	4.67	4.67	5.00	5.00	4.83
Petunia	Supertunia®	'Blush Pink'	PW	4.67	5.00	5.00	4.67	4.83
Vinca	Titan™	'Blush'	BS	4.33	5.00	5.00	5.00	4.83
Ageratum	Artist™	'Blue Violet'	PW	5.00	5.00	5.00	4.33	4.83
Petunia	Easy Wave®	'Blue'	PAS	4.33	5.00	5.00	5.00	4.83
Petunia	Madness	'Salmon Morn'	BS	4.00	5.00	5.00	5.00	4.75
Ageratum	Artist™	'Blue'	PW	4.67	5.00	5.00	4.33	4.75
Coleus		**'Pink Chaos'**	**PW**	**4.33**	**5.00**	**5.00**	**4.67**	**4.75**
Ornamental pepper		'Black Pearl'	PAS	4.00	5.00	5.00	5.00	4.75
Petunia	Supertunia®	'Mini Pastel Pink'	PW	4.67	4.33	5.00	5.00	4.75
Petunia	Surfinia®	'Patio Blue'	JP	4.67	4.67	4.67	5.00	4.75
Vinca	Titan™	'Polka Dot'	BS	4.00	5.00	4.67	5.00	4.67
Petunia	Supertunia®	'Cotton Candy'	PW	5.00	4.67	4.67	4.33	4.67
Petunia	Surfinia®	'Blue Veined Improved'	JP	4.33	4.33	5.00	5.00	4.67
Vinca	Cooler™	'Red Improved'	BS	3.33	5.00	5.00	5.00	4.58
Heuchera	Dolce™	'Licorice'	PW	4.00	4.67	4.67	5.00	4.58
Lamium		'Pink Chablis'	PW	4.67	5.00	3.67	5.00	4.58
Ageratum	Artist™	'Purple'	PW	5.00	5.00	5.00	3.33	4.58
Coleus		**'Sedona'**	**PW**	**4.67**	**5.00**	**4.67**	**3.67**	**4.50**
Vinca	Pacifica	'Red Dark'	BS	3.33	5.00	4.67	5.00	4.50
Vinca	Pacifica	'White Pure'	PAS	3.00	5.00	5.00	5.00	4.50
Diascia	Flying Colors™	'Red'	PW	5.00	5.00	3.00	5.00	4.50
Nemesia	Sunsatia™	'Raspberry'	PW	5.00	5.00	3.67	4.33	4.50
Petunia	Surfinia®	'Lavendar Lace'	JP	4.33	4.33	4.67	4.67	4.50
Vinca	Pacifica	'Rose Halo'	PAS	3.33	4.67	4.67	5.00	4.42
Vinca	Titan™	'Burgundy'	BS	3.00	5.00	4.67	5.00	4.42
Ageratum	High Tide™	'Blue'	BS	4.33	4.67	4.00	4.67	4.42
Anagallis		'Wildcat™ Orange'	PW	5.00	5.00	4.00	3.67	4.42
Angelonia	Serena™	'Lavender'	PAS	3.00	5.00	5.00	4.67	4.42
Angelonia	Serena™	'White'	PAS	3.00	5.00	5.00	4.67	4.42
Coleus	**Drop**	**'Strawberry'**	**PW**	**3.67**	**5.00**	**4.33**	**4.67**	**4.42**
Heuchera		'Mocha Mint'	PW	3.33	4.67	4.67	5.00	4.42

Table 2 (continued). Clark County 2005 Field Trial Ratings.								
Plant Name	**Series**	**Cultivar**	**Source**	**June**	**July**	**Aug**	**Sept**	**Overall Rating**
Pulmonaria	Gaelic™	'Spring'	PW	3.33	5.00	4.33	5.00	4.42
Ornamental Millet		'Purple Baron'	BS	5.00	5.00	4.00	3.67	4.42
Petunia	Easy Wave®	'Red'	PAS	4.00	4.67	4.67	4.33	4.42
Gaura	Stratosphere	'Pink Picotee'	PW	3.67	4.67	4.67	4.67	4.42
Herb Lavender		'Lavance'	BS	3.33	4.33	5.00	5.00	4.42
Petunia	Surfinia®	'Wild Plum'	JP	4.33	4.67	4.33	4.33	4.42
Verbena	Temari®	'Sakura Pink'	JP	3.33	5.00	4.33	4.67	4.33
Begonia	Emperor	'Soft Pink'	SAK	3.67	4.67	4.00	5.00	4.33
Impatiens	Stardust	'Cherry'	PAS	3.67	4.67	4.33	4.67	4.33
Coleus	**Drop**	**'Brown Sugar'**	**PW**	**3.67**	**4.67**	**4.33**	**4.67**	**4.33**
Helenium		'Dakota Gold'	BS	4.33	5.00	4.00	4.00	4.33
Impatiens hawkeri	**Infinity™**	**'Ruby Flash'**	**PW**	**2.67**	**5.00**	**4.67**	**5.00**	**4.33**
Petunia	Surfinia®	'Giant Blue'	JP	3.33	4.33	4.67	5.00	4.33
Verbena	Tapien™	'Lilac'	JP	4.00	5.00	5.00	3.00	4.25
Vinca	Pacifica	'Really Red'	PAS	2.67	4.67	4.67	5.00	4.25
Ageratum	High Tide™	'White'	PAS	4.67	4.33	3.67	4.33	4.25
Coleus	Drop	'Chocolate'	PW	3.67	5.00	3.67	4.67	4.25
Begonia	Emperor	'Rose Halo'	SAK	3.33	4.00	4.33	5.00	4.17
Lantana		'Tropical Fruit'	PW	2.67	5.00	4.33	4.67	4.17
Impatiens	**Fanciful**	**'White'**	**BS**	**4.00**	**4.33**	**4.67**	**3.67**	**4.17**
Angelonia	Angelface®	'Pink'	PW	2.67	4.67	4.33	4.67	4.08
Verbena	Temari®	'Patio White'	JP	3.67	5.00	4.67	3.00	4.08
Impatiens	**Dazzler**	**'Violet Improved'**	**BS**	**4.33**	**4.00**	**4.33**	**3.67**	**4.08**
Carex trifida			S	3.67	4.33	4.33	4.00	4.08
Mecardonia		'Gold Flake'™	PW	2.67	4.00	4.33	5.00	4.00
Coleus	**Giant Exhibition**	**'Palisandra'**	**S**	**4.00**	**5.00**	**4.00**	**3.00**	**4.00**
Euphorbia		'Helena'	PW	3.00	5.00	3.00	5.00	4.00
Petunia	Madness	'Lavender Glow'	BS	3.33	3.67	4.00	4.67	3.92
Geranium	Black Velvet	'Scarlet Improved'	S	4.00	4.67	3.67	3.33	3.92
Lavandula multifida		'Origano'	S	4.00	5.00	3.33	3.33	3.92
Sutera		**'Giant Snowflake®'**	**PW**	**4.00**	**4.67**	**2.33**	**4.67**	**3.92**
Begonia	Emperor	'Red'	SAK	2.67	4.00	4.00	5.00	3.92
NG Impatiens	**Infinity™**	**'Crimson'**	**PW**	**2.67**	**5.00**	**4.33**	**3.33**	**3.83**
Torenia	**Catalina™**	**'Midnight Blue'**	**PW**	**3.67**	**4.33**	**3.33**	**4.00**	**3.83**
Leucan-themum		'Broadway Lights'	PW	2.67	4.67	4.67	3.33	3.83
Begonia	Emperor	'Pink'	SAK	2.67	4.00	3.67	5.00	3.83
Begonia	Emperor	'White'	SAK	3.00	3.67	3.67	5.00	3.83
Impatiens	**Dazzler**	**'Burgundy Improved'**	**BS**	**4.33**	**4.00**	**4.00**	**3.00**	**3.83**

Table 2 (continued). Clark County 2005 Field Trial Ratings.								
Plant Name	**Series**	**Cultivar**	**Source**	**June**	**July**	**Aug**	**Sept**	**Overall Rating**
Lobelia	**Laguna™**	**'Compact Blue W/ Eye'**	**PW**	**5.00**	**4.33**	**3.33**	**2.67**	**3.83**
Coleus	**Giant Exhibition**	**'Limelight'**	**S**	**4.00**	**4.33**	**4.00**	**3.00**	**3.83**
Angelonia	Angelface®	'Dresden Blue'	PW	2.67	4.00	4.00	4.33	3.75
Anisodentia		'Little Lady'	PW	4.33	3.67	3.67	3.33	3.75
Dianthus	Dynasty	'Orchid'	BS	4.33	4.00	3.33	3.33	3.75
Thungbergia		'African Sunset'	S	3.00	3.67	4.33	4.00	3.75
Nemesia	Sunsatia™	'Mango'	PW	4.67	4.00	3.67	2.67	3.75
Petunia	Easy Wave®	'Shell Pink Improved'	BS	2.67	4.00	4.33	4.00	3.75
Calibrachoa	Million Bells®	'Lavender'	JP	4.33	4.00	4.33	2.33	3.75
Torenia	**Catalina™**	**'Blue'**	**PW**	**3.33**	**4.67**	**3.33**	**3.33**	**3.67**
Dianthus	Dynasty	'Pink Magic'	BS	4.00	3.67	3.33	3.33	3.58
Laurentia		'Beth's Blue'	PW	4.00	4.67	3.00	2.67	3.58
Sutera	**Glacier**	**'Blue'**	**PW**	**4.33**	**4.67**	**2.00**	**3.33**	**3.58**
Torenia	**Catalina™**	**'Purple'**	**PW**	**3.67**	**4.67**	**3.00**	**3.00**	**3.58**
Coreopsis		'Sunfire'	PAS	3.33	4.33	3.00	3.67	3.58
Pentas	Butterfly	'Pink'	BS	1.33	3.67	4.33	5.00	3.58
Pentas	Butterfly	'Light Lavender Improved'	BS	1.33	3.67	4.33	5.00	3.58
Impatiens	**New Guinea**	**Experimental NG**	**BS**	**2.67**	**4.00**	**3.33**	**4.00**	**3.50**
Sutera	**Snowstorm®**	**'Ice Blue**	**PW**	**4.00**	**5.00**	**1.67**	**3.33**	**3.50**
Petunia	Surfinia®	'Rose Vein'	JP	3.33	3.67	3.33	3.67	3.50
Sutera	**Snowstorm®**	**'Pink'**	**PW**	**4.00**	**4.67**	**1.67**	**3.33**	**3.42**
Petunia	Surfinia®	'Patio White'	JP	4.67	2.67	3.00	3.33	3.42
Stachys		'Sentimental Journey'	PW	2.33	4.00	3.67	3.67	3.42
Petunia	Easy Wave®	'Rosy Dawn'	PAS	2.67	4.00	3.33	3.33	3.33
Calibrachoa	Superbells®	'Plum'	PW	4.00	4.67	2.33	2.00	3.25
Convolvulus		'Blue Casbah'	PW	2.67	4.33	3.33	2.67	3.25
Hibiscus	Luna™	'Pink Swirl'	BS	1.33	2.67	4.33	4.67	3.25
Lobelia	**Laguna™**	**'Sky Blue'**	**PW**	**5.00**	**4.33**	**1.33**	**2.33**	**3.25**
Coleus	**Wizard®**	**'Mosaic'**	**PAS**	**2.67**	**4.33**	**3.67**	**2.33**	**3.25**
Nemesia	Sunsatia™	'Peach'	PW	4.33	3.00	2.33	3.33	3.25
Torenia	**Catalina™**	**'Pink'**	**PW**	**3.67**	**4.33**	**2.33**	**2.33**	**3.17**
Asteriscus		'Aurelia Gold'	PW	2.67	4.33	2.67	3.00	3.17
Coleus	**Kong**	**'Red'**	**PAS**	**3.67**	**4.00**	**3.00**	**2.00**	**3.17**
Hibiscus	Luna™	'White'	BS	1.33	2.67	4.33	4.33	3.17
Lobelia	**Laguna™**	**'White'**	**PW**	**4.67**	**3.67**	**1.33**	**2.67**	**3.08**
Lotho-spermum		'Wine Red'	JP	3.00	3.33	2.33	3.00	2.92
Sutera	**Cabana**	**'Trailing Blue'**	**PW**	**3.00**	**3.67**	**1.67**	**3.33**	**2.92**
Portulaca	Tequila™	'Yellow'	PAS	3.33	4.67	3.33	Died before the final evaluation	
Portulaca	Tequila™	'Cherry'	BS	3.67	4.67	2.33		
Nemesia	Sunsatia™	'Coconut'	PW	5.00	4.33	2.00		

Table 2 (continued). Clark County 2005 Field Trial Ratings.								
Plant Name	**Series**	**Cultivar**	**Source**	**June**	**July**	**Aug**	**Sept**	**Overall Rating**
Sanvitalia		'Sunbini'	PW	3.00	4.00	4.00	Died before the final evaluation	
Argyranthemum		'Vanilla Butterfly'	PW	4.67	3.67			
Calibrachoa	Million Bells®	'Trailing Magenta'	JP	4.00	3.67			
Calibrachoa	Superbells®	'Tequila Sunrise'	PW	5.00	4.33			
Calibrachoa	Superbells®	'Peach'	PW	4.33	4.00			
Torenia	**Clown®**	**'Burgundy Improved'**	**PAS**	**2.00**	**1.67**			
Viola		**'Blue/white '**	**JP**	**2.33**	**3.00**			
Viola		**'Yellow'**	**JP**	**3.00**	**4.00**			
Phlox	Intensia®	'White'	PW	4.67	3.33			
Phlox	Intensia®	'Lavender Glow'	PW	3.33	1.67			
Petunia	Surfinia®	'Red'	JP	2.67	2.00	Died before the 3rd evaluation		
Verbena	Temari®	'Burgundy'	JP	3.00				
Alyssum	Rally	'Mix'	S	4.00				
Calibrachoa	Million Bells®	'Tangerine'	JP	4.33				
Nemesia	Sunsatia™	'Pineapple'	PW	4.33				
Nemesia	Sunsatia™	'Lemon'	PW	3.00				
Nemesia	Sunsatia™	'Cranberry'	PW	1.33				
Nemesia	Sunsatia™	'Banana'	PW	2.67				
Petunia	Carpet	'Pink Morn'	PAS	2.33				
Snapdragon	Snapshot™	'Mix'	BS	1.33				
Salvia argenta		'Artemis'	S	1.33	Died before the 2nd evaluation			
Argyranthemum	Molimba	'First Blush'	PW					
Calibrachoa	Million Bells®	'Flamingo'	JP					
Osteospermum	Soprano™	'Lilac Spoon'	PW					
Osteospermum	Soprano™	'Light Purple'	PW					
Osteospermum	Symphony	'Melon'	PW	Died before the 1st evaluation in June				

~ 9 ~

Results of Herbaceous Annual Plant Trial Gardens at the Cincinnati Zoo and Botanical Garden, 2005

David E. Dyke, Steve Foltz, and Brian Jorg

The Cincinnati Zoo and Botanical Garden (CZBG), in cooperation with Ohio State University Extension Hamilton County, and the Cincinnati Flower Growers Association, collaborated on demonstration/trial gardens in 2005. This was the fourth year for these collaborative trials.

As in past years, the trials were conducted with three goals. The first was to evaluate herbaceous annuals on the basis of quality and performance throughout the growing season in order to determine which should be recommended for planting in area gardens.

The second was to provide the general public and commercial growers and landscapers an opportunity to observe many varieties of the latest, yet fairly well-proven, available annuals that were professionally grown in attractive garden settings (including in planters).

The third was to promote those annuals that performed well enough to be recommended for planting in area gardens.

Participating seed companies included Pan American Seed Co., Ball Flora, Proven Winners, and Michell's. These companies provided seeds and plugs to the trial program. More than 13,000 plants of 150 varieties were planted in the trials.

The selected plants were grown in 4" pots. They were then installed in display beds throughout the grounds of the CZBG. All varieties were labeled and grown using a liquid fertilization schedule, which included fertilization at installation, and a light feeding at two-week intervals. Once established, fertilization was used as necessary to maintain the plants. No fungicide, insecticide, or herbicide applications were made.

Evaluations were conducted by members of the cooperating organizations throughout the growing season. A scale from one to five was used, with one being poor and five excellent. The ratings were based on overall appearance, color, impact, health of the plants, and vigor.

The winners needed to score high throughout the entire season. Poor performers were taken off the rating schedule. There was a very large gap between the score of the nine cultivars selected as the Zoo's Best this year and the remaining plants in the trials. However, many others did very well and would make great additions to area gardens.

The growing season was decidedly hot, with close to 40 days over 90ºF. Some

David E. Dyke, Ohio State University Extension, Hamilton County; Steve Foltz, Director of Horticulture, Cincinnati Zoo and Botanical Garden, Cincinnati, Ohio; and Brian Jorg, Manager of Horticulture, Cincinnati Zoo and Botanical Garden, Cincinnati, Ohio.

varieties completely shut down floral production due to the heat. The chosen winners, however, continued to flower through the peak summer heat. Sustained dry periods were encountered, and beds were supplemented with automatic irrigation and hand watering.

The Cincinnati Zoo and Botanical Garden receives approximately 1.2 million visitors per year. Many of these visitors, as well as professional organizations, use these display beds as resources to make informed choices.

The Top Picks of the 2005 "Zoo's Best" Annual Trials

'Juliet Quartermain' Coleus tolerates both sun and shade. This 24"- to 30"-tall plant has brick-red foliage with scalloped edges tipped with yellow. Growth habit is extremely uniform.

'Morning Glow' Lantana Orange/Yellow prefers full sun and reaches a height of 18". Very bright luminescent orange-yellow flowers glow in the garden.

'Sweet Caroline' Purple Sweet Potato tolerates sun or part shade. This groundcover grows to 15" in height and has dark glossy foliage that provides consistent color in the landscape. This compact grower is a top performer in the garden.

'Celebrette Frost' New Guinea Impatiens grows in part shade. At 18" to 24", this mounding plant had good heat tolerance and large white flowers that bloomed prolifically throughout the summer.

'Life Lime' Coleus is another coleus that takes full sun or part shade. Growing to 24" to 30", this nice compact, upright grower has bright chartreuse foliage that adds a sparkling lime accent to the landscape.

'Star Orange' Zinnia grows in full sun, attaining a height of 12". Small orange flowers are held above fine foliage. Sporting masses of flowers throughout the season, it thrives in summer heat and intensifies with fall temperatures, lasting well through October.

'Landmark Gold' Lantana grows in full sun to 18". It has a mounding habit with bright gold/yellow flowers. This annual is a great choice for hot and dry gardens.

'Fanfare™ Orange' Impatiens grows in part shade to 24" to 30". Bright, vivid orange color for the shady garden; it is a nonstop performer all summer.

'eXtreme Soft Pink' Vinca is a great performer in full sun. Growing to 12", this drought-tolerant annual produces beautiful soft pink flowers with a dark pink eye. Extremely floriferous through the heat of summer, this is a great summer annual.

For more information, contact Steve Foltz or Brian Jorg, Cincinnati Zoo and Botanical Garden Horticulture Department at 513-475-6106, or Dave Dyke at 513-505-1202.

More information on previous Trial Winners can be found at:

www.cincinnatizoo.org

http://www.cincinnatiflowergrowers.org

and at www.ohioline.osu.edu.

"

~ 10 ~

The Ohio State University Learning Gardens Pansy/Viola Cultivar Trial, 2004 - 2005

Monica Kmetz-Gonzalez, Annette Duetz, Claudio Pasian

Introduction

This was the fifth year we conducted our Pansy and Viola Trials. Plants were transplanted outside in late September to early October and evaluated later in the fall, then throughout the winter and spring. This report presents the results of our evaluations, both the Plant Characteristic Evaluation performed by the Trials Leader and Trials Managers, and the Consumer Preference Evaluation performed by our team of Master Gardeners.

Trial Site Location

The trial was conducted in a new in-ground trial site adjacent to our departmental buildings, in an area of high visibility on the Columbus campus. The beds received full sun after 10 a.m.

Plant Material

Seed from participating breeders and distributors was grown once again for us this year by Bob Barnitz of Bob's Market & Greenhouse, Mason, West Virginia. There were 24 Pansy entries (11 "panola" types) and 9 Violas, bringing the total number of cultivars evaluated to 33.

Procedure

Plants were received in our greenhouses on Sept. 29 in 2-1/4-inch cell paks. A Plantshield drench (5 oz/100 gal) was applied on the following day.

Fifteen plants per cultivar were transplanted in-ground between Sept. 30 and Oct. 5. Spacing was 15" between plants in a row, 12" between rows of the same cultivar, and 18" between different cultivars. Post-planting fertilization occurred on Oct. 7 with 200 ppm N of a 20-10-20 soluble fertilizer via Dosatron.

Weather Conditions

The winter was wetter than average (with several winter rains in addition to snow and ice), and the lowest temperature occurred on Dec. 25, 2004, when -5ºF (-21.1ºC) was recorded.

Evaluations

Three types of evaluations were performed:

Plant Characteristics were evaluated in depth by our Trial Leader and Trial Managers. Ratings were based on a 1 to 5 scale (1 = Not Acceptable, 5 = Exceptional).

Monica Kmetz-Gonzalez, The Ohio State University, Department of Horticulture and Crop Science; Annette Duetz, The Ohio State University, Department of Horticulture and Crop Science; and Claudio Pasian, The Ohio State University, Department of Horticulture and Crop Science.

These characteristics were evaluated:

- Flower quality/appearance: aesthetics, color, health, and appearance.
- Flower number: 1 = low, 5 = very floriferous.
- Vegetative growth/foliage: vegetative vigor, aesthetics/color, health, and appearance.
- Overall: overall rating for the group, taking all the previous criteria into consideration.

Plant characteristic evaluations were performed on April 13, 2005 (Table 1) and May 6, 2005 (Table 2).

Consumer Preference Evaluations were performed by our team of Master Gardener Volunteers. These evaluations were based purely on personal preference on a 1 to 5 scale, rating the overall appearance of the individual cultivars (1 = Do Not Like; 5 = Like The Most).

These evaluations were performed on April 28, 2005, and May 3, 2005, by our 11-member team of Master Gardeners (Table 3).

Winter Hardiness was based on the number of surviving plants per cultivar (Table 4).

Results

The results of the Spring 2005 evaluation are presented here. It is important to remember that the plants we evaluated had spent the winter in the ground outdoors.

Top Performers

Top performers (4.0+ rating) in the final evaluations performed by the Trial Leader and Trial Managers were: panola (pansy) 'Nature Beacon,' 'Pansy Matrix Blue & Yellow,' 'Viola Gem Ice Blue,' 'Viola Gem Purple,' and 'Viola Gem Red w/ Blotch.'

Top performers (4.0+ average) in our Consumer Preference Trial, as rated by our Master Gardener volunteer team, were: panola (pansy) 'Nature Beacon,' panola 'Panola Blue Sky,' panola 'Panola Violet Picotee,' 'Pansy Fama Purple Improved,' 'Viola Gem Ice Blue,' and 'Viola Sorbet Icy Blue.'

Top overall performers for all plant types, with an equal score, in the Consumer Preference Trial, were: panola (pansy) 'Nature Beacon' and 'Viola Gem Ice Blue.'

Acknowledgments

We would like to acknowledge our dedicated team of Master Gardener Volunteers who helped in all phases of this trial. Thanks to Greenhouse Supervisor David Snodgrass and several student workers for their assistance. We thank Bob Barnitz of Bob's Market & Greenhouse for seeding and growing on the transplants. We thank Bioworks for their donation of Plantshield.® And we thank these companies for their participation in this year's trial:

Benary
http://www.benary.com

PanAmerican Seeds
http://www.panamseed.com

Takii
http://www.takii.com

Table 1. Evaluation of Plant Characteristics.* Ohio State Learning Gardens, Columbus Campus, 2004-2005 Pansy and Viola Trial.

Spring Rating 4/13/05
Rating scale: 1 = poor; 5 = excellent.

Type	Series	Cultivar	Seed Company	Flower Appearance	Flower Number	Vegetative Growth/ Foliage	Uniformity	Overall
panola	Panola	Violet Picotee	PanAmerican	4.75	4.75	4.5	4.75	4.75
panola	Panola	Blue Sky	PanAmerican	4.5	4.5	4.75	4.25	4.5
panola (pansy)	Nature	Beacon	Takii	4	5	4	4.5	4.5
panola (pansy)	Nature	Ocean	Takii	3.5	4.5	3.75	2.75	4
panola (pansy)	Nature	Blue	Takii	3.5	4.5	3.75	3.75	3.75
panola (pansy)	Nature	Rose w/ Blotch	Takii	3.25	3.5	3	2.5	3
panola (pansy)	Nature	White	Takii	3.25	2	2	2.5	2.25
panola (pansy)	Nature	Yellow	Takii	2.5	2.75	2	1	2
panola	Panola	Rose	PanAmerican	3.75	1.5	1.5	1	1.5
panola	Panola	Orange Improved	PanAmerican	2.75	1	1.5	1.25	1.5
panola	Panola	Scarlet	PanAmerican	N/A	1	1.5	0.5	1
Pansy	Matrix	Clear White	PanAmerican	2.5	2.75	2.75	3.75	3.5
Pansy	Fama	Purple Improved	Benary	2.5	2	3	3.75	3
Pansy	Fama	Dark-Eyed Red Imp.	Benary	2.75	2.75	3	2.5	2.75
Pansy	Matrix	Blue & Yellow	PanAmerican	3	2.5	3.25	2.5	2.75
Pansy	Matrix	Blue Frost	PanAmerican	3.5	2.75	2.75	2.75	2.75
Pansy	Matrix	Clear Yellow	PanAmerican	2	2	2	2.75	2.5
Pansy	Fama	Dark-Eyed Yellow Imp.	Benary	2.25	2.75	2	2.25	2
Pansy	Matrix	Ocean	PanAmerican	3	1.25	2	3.5	2
Pansy	Matrix	Blue w/ Blotch	PanAmerican	2	1.25	2	1.5	1.5
Pansy	Matrix	Yellow w/ Blotch	PanAmerican	N/A	1	1.5	2	1.5
Pansy	Fama	Ruby	Benary	N/A	1	1	3.5	1
Pansy	Treasure	White w/Red Blotch	Benary		1	N/A	N/A	N/
Pansy	Matrix	Sunrise	PanAmerican	N/A	N/A	N/A	N/A	N/A
Viola	Sorbet	Icy Blue	PanAmerican	4.5	4	4	5	4.75
Viola	Gem	Icy Blue	Takii	5	5	4.75	4.75	4.75
Viola	Sorbet	Primrose Babyface	PanAmerican	4.5	3.75	4	5	4.5
Viola	Gem	Lavender	Takii	2.75	3.75	3.75	4	4
Viola	Gem	White	Takii	3	3	4.5	4.75	4

Table 1 (continued). Evaluation of Plant Characteristics.* Ohio State Learning Gardens, Columbus Campus, 2004-2005 Pansy and Viola Trial.

Spring Rating 4/13/05
Rating scale: 1 = poor; 5 = excellent.

Type	Series	Cultivar	Seed Company	Flower Appearance	Flower Number	Vegetative Growth/ Foliage	Uniformity	Overall
Viola	Gem	Apricot Antique	Takii	2.5	3	3.5	4.5	3.75
Viola	Gem	Red w/Blotch	Takii	3.5	3	3.25	3.5	3.5
Viola	Gem	Purple	Takii	4	2	3	4.75	2.75
Viola	Gem	Pink Antique	Takii	2.75	2.5	3	3.5	2.75

*Performed by Trial Leader and Trial Manager

Table 2. Evaluation of Plant Characteristics.* Ohio State Learning Gardens, Columbus Campus, 2004-2005 Pansy and Viola Trial.

Spring Rating 4/13/05
Rating scale: 1 = poor; 5 = excellent.

Type	Series	Cultivar	Seed Company	Flower Appearance	Flower Number	Vegetative Growth/ Foliage	Uniformity	Overall
panola (pansy)	Nature	Beacon	Takii	3.00	4.75	4.75	4.00	4.75
panola (pansy)	Nature	Ocean	Takii	4.50	4.75	4.00	3.75	4.00
panola (pansy)	Nature	Rose w/ Blotch	Takii	3.00	3.75	3.75	3.75	4.00
panola (pansy)	Nature	Blue	Takii	3.00	4.00	4.00	3.75	4.00
panola (pansy)	Nature	Yellow	Takii	4.25	3.75	3.00	2.75	3.00
panola (pansy)	Nature	White	Takii	3.00	3.00	3.25	2.00	3.00
panola	Panola	Violet Picotee	PanAmerican	4.75	4.50	4.75	5.00	5.00
panola	Panola	Blue Sky	PanAmerican	4.75	4.75	4.50	4.00	4.75
panola	Panola	Scarlet	PanAmerican	3.50	3.00	2.00	1.75	2.75
panola	Panola	Rose	PanAmerican	3.25	2.75	2.75	2.00	2.50
panola	Panola	Orange Improved	PanAmerican	2.50	2.00	2.00	1.50	2.00
Pansy	Matrix	Blue & Yellow	PanAmerican	4.00	3.25	3.75	4.00	4.75
Pansy	Matrix	Blue Frost	PanAmerican	3.50	3.75	3.50	4.00	4.00
Pansy	Fama	Purple Improved	Benary	2.25	3.75	3.00	4.25	3.75
Pansy	Fama	Dark-Eyed Red Imp.	Benary	2.75	4.00	3.75	4.00	3.75

Table 2 (continued). Evaluation of Plant Characteristics.* Ohio State Learning Gardens, Columbus Campus, 2004-2005 Pansy and Viola Trial.

Spring Rating 4/13/05
Rating scale: 1 = poor; 5 = excellent.

Type	Series	Cultivar	Seed Company	Flower Appearance	Flower Number	Vegetative Growth/ Foliage	Uniformity	Overall
Pansy	Matrix	Clear White	PanAmerican	2.00	3.50	3.50	4.00	3.75
Pansy	Matrix	Clear Yellow	PanAmerican	3.00	2.75	3.50	3.75	3.75
Pansy	Matrix	Yellow w/ Blotch	PanAmerican	3.00	2.75	2.50	2.00	3.00
Pansy	Matrix	Ocean	PanAmerican	3.00	2.75	2.75	2.50	3.00
Pansy	Fama	Dark-Eyed Yellow Imp.	Benary	2.75	3.25	2.00	3.50	2.75
Pansy	Fama	Ruby	Benary	2.50	2.75	1.75	2.00	2.50
Pansy	Matrix	Blue w/ Blotch	PanAmerican	2.50	2.50	2.00	2.00	2.50
Pansy	Matrix	Sunrise	PanAmerican	3.00	2.00	2.00	2.00	2.00
Pansy	Treasure	White w/ Red Blotch	Benary	N/A	N/A	N/A	N/A	N/A
Viola	Gem	Ice Blue	Takii	4.50	4.75	5.00	5.00	4.75
Viola	Gem	Purple	Takii	4.50	3.75	4.00	4.75	4.50
Viola	Gem	Red w/ Blotch	Takii	4.75	4.00	4.00	3.75	4.50
Viola	Sorbet	Icy Blue	PanAmerican	3.75	3.75	4.00	5.00	4.00
Viola	Gem	White	Takii	4.75	4.00	4.00	4.75	4.00
Viola	Sorbet	Primrose Babyface	PanAmerican	2.75	2.50	2.50	4.75	3.50
Viola	Gem	Lavender	Takii	2.00	3.00	3.50	3.75	3.50
Viola	Gem	Apricot Antique	Takii	2.00	3.00	4.00	4.75	3.00
Viola	Gem	Pink Antique	Takii	2.00	2.50	3.50	4.00	3.00

*Performed by Trial Leader and Trial Manager

Table 3. Consumer Preference Evaluation. Ohio State Learning Gardens, Columbus Campus, 2004-2005 Pansy and Viola Trial.

SPRING Rating 4/28/05 and 5/3/05
Rating scale: 1 = poor; 5 = excellent.

Type	Series	Cultivar	Seed Company	Consumers											Avg. Rating
				1	2	3	4	5	6	7	8	9	10	11	
Viola	Gem	Ice Blue	Takii	5	5	4	5	5	5	5	5	4	4	5	4.73
panola (pansy)	Nature	Beacon	Takii	5	5	5	4	5	5	4	5	5	4	5	4.73
panola	Panola	Blue Sky	PanAmerican	4	4	5	5	5	5	4	5	4	4	5	4.55
Viola	Sorbet	Icy Blue	PanAmerican	5	4	5	5	4	5	4	5	4	4	5	4.54
panola	Panola	Violet Picotee	PanAmerican	4	3	5	4	5	4	4	4	3	4	5	4.09
Pansy	Fama	Purple Improved	Benary	4	5	4	4	4	4	4	5	3	4	4	4.09
Viola	Gem	White	Takii	5	5	4	4	4	3	3	5	3	4	4	4.00
panola (pansy)	Nature	Ocean	Takii	4	3	5	4	5	3	4	4	3	5	4	4.00
panola (pansy)	Nature	Blue	Takii	5	3	4	4	5	4	4	4	4	3	4	4.00
Pansy	Matrix	Clear Yellow	PanAmerican	4	3	5	4	5	4	3	5	3	4	3	3.91
panola (pansy)	Nature	Rose w/ Blotch	Takii	4	3	4	4	5	4	4	4	3	3	4	3.82
Viola	Gem	Purple	Takii	5	5	4	4	4	2	3	5	2	4	4	3.82
Pansy	Fama	Dark-Eyed Red Imp.	Benary	4	5	4	4	4	3	3	3	4	4	4	3.82
Viola	Gem	Red w/ Blotch	Takii	5	5	4	4	4	2	4	4	3	3	3	3.73
Pansy	Matrix	Ocean	PanAmerican	4	3	4	4	5	3	4	4	3	4	3	3.73
Pansy	Matrix	Blue & Yellow	PanAmerican	4	4	5	3	5	4	2	4	4	3	3	3.73
Pansy	Matrix	Blue Frost	PanAmerican	4	3	5	3	4	5	3	4	3	3	3	3.64
Viola	Gem	Lavender	Takii	4	5	3	4	3	2	2	5	3	3	3	3.36
Pansy	Matrix	Yellow w/ Blotch	PanAmerican	4	3	2	3	5	3	2	4	3	3	2	3.09
panola (pansy)	Nature	White	Takii	4	3	3	3	3	3	3	3	3	2	4	3.09
Viola	Sorbet	Primrose Babyface	PanAmerican	4	5	2	4	3	2	2	4	2	2	3	3.00
Viola	Gem	Pink Antique	Takii	4	4	3	3	5	1	1	4	2	3	3	3.00
Viola	Gem	Apricot Antique	Takii	3	4	3	4	5	1	1	4	2	2	4	3.00
panola (pansy)	Nature	Yellow	Takii	3	3	3	3	4	2	2	3	3	3	3	2.90
panola	Panola	Rose	PanAmerican	3	3	3	2	3	2	2	3	2	2	3	2.55
Pansy	Fama	Dark-Eyed Yellow Imp.	Benary	4	2	2	3	3	2	2	3	3	2	2	2.55
Pansy	Matrix	Blue w/ Blotch	PanAmerican	3	2	3	3	2	2	3	3	2	2	2	2.45

Table 3 (continued). Consumer Preference Evaluation. Ohio State Learning Gardens, Columbus Campus, 22004-2005 Pansy and Viola Trial.

SPRING Rating 4/28/05 and 5/3/05
Rating scale: 1 = poor; 5 = excellent.

Type	Series	Cultivar	Seed Company	Consumers											Avg. Rating
				1	2	3	4	5	6	7	8	9	10	11	
Pansy	Fama	Ruby	Benary	2	2	2	1	2	1	1	2	2	2	2	1.72
panola	Panola	Orange Improved	PanAmerican	2	2	2	1	3	2	1	2	1	1	2	1.72
panola	Panola	Scarlet	PanAmerican	2	2	1	2	2	1	1	2	1	2	1	1.54
Pansy	Matrix	Sunrise	PanAmerican	2	1	1	1	2	1	2	1	1	1	1	1.27
Pansy	Treas-ure	White w/ Red Blotch	Benary	1	1	1	1	1	1	1	1	1	1	1	1.00

Table 4. Plant Winter Hardiness. Pansy/ Viola Trial 2005.				
Taken on 5/6/05				
Type	**Series**	**Cultivar**	**Seed Company**	**Dead Plants Out of 12**
panola	Panola	Blue Sky	PanAmerican	0
panola	Panola	Violet Picotee	PanAmerican	0
panola	Panola	Rose	PanAmerican	1
panola (pansy)	Nature	Rose w/ Blotch	Takii	1
panola (pansy)	Nature	Beacon	Takii	1
panola	Panola	Orange Improved	PanAmerican	2
panola	Panola	Scarlet	PanAmerican	2
panola (pansy)	Nature	Ocean	Takii	2
panola (pansy)	Nature	Blue	Takii	2
panola (pansy)	Nature	White	Takii	2
panola (pansy)	Nature	Yellow	Takii	3
Pansy	Matrix	Blue Frost	PanAmerican	0
Pansy	Matrix	Clear White	PanAmerican	0
Pansy	Matrix	Clear Yellow	PanAmerican	0
Pansy	Fama	Purple Improved	Benary	1
Pansy	Fama	Dark-Eyed Red Imp.	Benary	1
Pansy	Matrix	Blue & Yellow	PanAmerican	1
Pansy	Matrix	Ocean	PanAmerican	1
Pansy	Matrix	Blue w/ Blotch	PanAmerican	3
Pansy	Fama	Ruby	Benary	4
Pansy	Matrix	Yellow w/ Blotch	PanAmerican	4
Pansy	Fama	Dark-Eyed Yellow Imp.	Benary	5
Pansy	Matrix	Sunrise	PanAmerican	5
Pansy	Treasure	White w/ Red Blotch	Benary	12
Viola	Sorbet	Icy Blue	PanAmerican	0
Viola	Sorbet	Primrose Babyface	PanAmerican	0
Viola	Gem	Lavender	Takii	0
Viola	Gem	White	Takii	0
Viola	Gem	Purple	Takii	0
Viola	Gem	Red w/ Blotch	Takii	0
Viola	Gem	Apricot Antique	Takii	0
Viola	Gem	Ice Blue	Takii	0
Viola	Gem	Pink Antique	Takii	0

”””

~ 11 ~

The Ohio State University Learning Gardens Osteospermum Cultivar Trial, 2005

Monica Kmetz-Gonzalez, Annette Duetz, Claudio Pasian

In 2005, we conducted our eighth Osteospermum/African Daisy Trial in our departmental greenhouses on the Columbus campus. Twelve entries from two different companies were trialed, from January through early May. Rooted cuttings were received from participating companies between January 12 and 20, 2005.

Cultural Schedule

January 18 – January 20 (Week 3)

Rooted cuttings of 20 plants per cultivar were transplanted to 4.5-inch pots. Potting media: MetroMix 360. Greenhouse temperature: 72ºF day/night.

Note: Crescendo Ivory had dieback and yellowing on the bottom leaves.

February 15 (Week 7)

Plants pinched to 5 or 6 nodes.

March 1 (Week 9)

Cold vernalization initiated: 46ºF day/night

April 13 (Week 15)

Temperature changed back to warm: 65ºF day/55ºF night

May 3 – May 11 (Weeks 18 – 19)

Cultivars reached peak flowering.

Fertilization

The first week after transplanting, 20-10-20 at 200 ppm, three times per week, was applied.

After January 24, fertilizer was changed to Greencare 17-5-17 at 200 ppm N, three times per week.

Disease Problems

Neither Pythium nor Botrytis were a factor in this year's trial.

Height Control

No growth regulators were used in this cultivar evaluation. This provided a good indicator of the natural growth habit of each cultivar.

Evaluations Performed

Plant Height to top of flowers (Table 1) was measured on May 3, 6, and 11. Height is presented in both centimeters and

Monica Kmetz-Gonzalez, The Ohio State University, Department of Horticulture and Crop Science; Annette Duetz, The Ohio State University, Department of Horticulture and Crop Science; and Claudio Pasian, The Ohio State University, Department of Horticulture and Crop Science.

inches, and the table is ranked in order of tallest to shortest cultivar.

The main Cultivar Evaluation (Table 2) was performed by the Trials Leader and Trials Managers on May 3, 6, and 11. The table is ranked in decreasing order of the Overall rating.

Evaluation Criteria

Ratings were based on a 1 to 5 scale:
1 = poor/not acceptable
2 = fair
3 = good
4 = very good
5 = excellent.

Plants were evaluated for the following characteristics:

- Flower number.
- Flower quality. Flower aesthetics, color, health, and appearance.
- Vegetative/foliage quality. Plant habit, plant vigor, leaf color, health, and appearance of vegetative portion of plants.
- Overall. Overall rating for all plants in the grouping, taking the previous aspects into consideration.

Results

The top entries (with an overall ranking of above 4.0) in the Cultivar Evaluation as rated by the Trials Leader and Trial Managers at the time of peak flower were Nasinga Cream and Experimental E-054. Also performing well, and all tied with a ranking of 4.0, were Wildside and Antique Pink.

Since no growth regulators were used in this trial, it was interesting to observe natural plant heights and habits. Final plant heights almost doubled from the shortest entry, Nasinga Cream (18.4 cm or 7.25 in.) to Margarita Rosita (28.2 or 11.1 in.).

There were only two entries finishing off below 20 cm (8 in.) — Experimental E-054 and Nasinga Cream. All of the trialed entries were then tested and evaluated in our test garden throughout the summer.

We would like to thank the following companies for their participation in this year's Greenhouse Trial:

- ECKE

  http://www.ecke.com
- FIDES North America

  http://www.fidesnorthamerica.com

Table 1. Greenhouse Trial. Osteospermum Cultivar Trial 2005, the Learning Garden.				
Plant Height * Measured on 5/3, 5/6, 5/11/05 at peak flowering				
Series	**Cultivar**	**Source**	**Avg. Height (cm)**	**Avg. Height (in)**
Margarita	Rosita	Fides	28.2	11.1
	Antique Pink	Ecke	27.2	10.7
	Wildside	Ecke	24	9.45
	Brightside	Ecke	23.7	9.33
Nasinga	Purple	Ecke	23.3	9.17
Experimental	E-097	Fides	23	9.06
	Crescendo Ivory	Ecke	22.4	8.82
	Yellow Tulip	Ecke	22.4	8.82
Margarita	Maria	Fides	20.6	8.9
Margarita	Carmen	Fides	20.6	8.9
Experimental	E-054	Fides	19.1	7.52
Nasinga	Cream	Ecke	18.4	7.25

Table 2. Greenhouse Trial. Osteospermum Cultivar Trial 2005, Ohio State.							
Series	**Cultivar**	**Source**	**Flower No.**	**Quality**	**Vigor & Habit**	**Overall**	**Eval. Date**
Nasinga	Cream	Ecke	5	4.5	5	4.75	5-11-05
Experimental	E-054	Fides	3.75	4.75	5	4.5	5-6-05
	Wildside	Ecke	4.5	3.5	4.5	4.25	5-6-05
	Antique Pink	Ecke	3.5	5	4	4	5-11-05
	Crescendo Ivory	Ecke	3	3.5	3.25	3.75	5-3-05
	Brightside	Ecke	2.75	3.25	4	3.75	5-6-05
Experimental	E-097	Fides	3.75	3	3.75	3.75	5-11-05
	Yellow Tulip	Ecke	4.25	4	2.75*	3.5	5-11-05
Margarita	Maria	Fides	3.5	3	3.25	3	5-3-05
Nasinga	Purple	Ecke	2.75	4.25	3	3	5-6-05
Margarita	Rosita	Fides	2.75	3	2.75	2.75	5-6-05
Margarita	Carmen	Fides	2.75	2	3.25	2.75	5-3-05
* Many yellow leaves at time of evaluation.							

,,,

~ 12 ~

2005 Annual Trials, Columbus Campus, In-Ground Trials

Annette Duetz and Claudio Pasian

The Ohio State University Annual Trials have expanded from about 4,000 sq. ft. to about 12,000 sq. ft. in 2005. The number of beds grew from 15 to 58, while the number of cultivars went from 120 to 430. It was only our second year of trialing in the in-ground beds located at the corner of Woody Hayes Drive and Fyffe Court, adjacent to our departmental buildings. This area is highly visible on the Columbus campus. Almost all of the beds are in full sun. More beds have been constructed for an even larger trial in 2006.

The other half of the trials was located behind (south) of Howlett Hall in our seven raised beds and along (west of) the Howlett Hall greenhouses headhouse in in-ground beds which were used this year for the first time.

General Information

Seeded entries were sown for us in March to early April by David Cuthbert at Darby Creek Growers, Orient, Ohio. They were then transplanted in our departmental greenhouses along with the majority of the vegetative entries around mid-April in 4" square containers donated by Dillen. After all the plants were treated with PlantShield (5 oz/100 gal) once, they were transplanted outside into the trial beds from May 16 through May 26.

In general, nine plants per cultivar were trialed on about 1 to 1.5 foot centers in 6-feet-wide beds. Spacing changed as needed by species/cultivars, ranging from 3 linear feet for the small growing cultivars to 4 and 5 linear feet for the more vigorous ones.

Watering and Fertilization

The new beds were fertilized once prior to planting with Greencare 17:5:17 at a rate of 200 ppm nitrogen via Dosatron. This pre-plant fertilization was done to accelerate decomposition of any organic matter left in the amendment donated by Kurtz Bros.

After planting, plants were watered as needed by hand and/or overhead sprinkler. Post-planting fertilization was done using Greencare 17:5:17 200 ppm N via Dosatron. Fertilization was repeated at two- to three-week intervals through July, especially in the newly established beds.

Weather Conditions

Prior to planting, seasonal conditions were wet and relatively cool. This slowed bed preparation, especially with new beds. After planting, conditions turned dry with normal to high temperatures. Overall, except for the leftovers of Hurricane

Annette Duetz, The Ohio State University, Department of Horticulture and Crop Science; and Claudio Pasian, The Ohio State University, Department of Horticulture and Crop Science.

Katrina, conditions were hot and very dry in Columbus.

Pest and Disease Problems

There were a few problems with root rot early in the season on a few susceptible species due to the cool, wet conditions. However, the only noticeable pests this year were Japanese beetles on the Millet and mites on the Tagetes late in the season. The verbenas were highly affected by mildew in July but rebounded beautifully in August and September. Rabbits and squirrels are constant guests at our trials, but they didn't seem to cause any noticeable damage this year.

Evaluation Dates

Evaluations were performed on a monthly basis, beginning approximately one month after transplanting. This year, plant characteristic ratings were performed on June 15, July 7 and 27, and September 7 by the Trials Leader and Trials Manager.

Evaluation Criteria

Ratings were based on a 1 to 5 scale: 1 = poor/not acceptable, 2 = fair, 3 = good, 4 = very good, 5 = excellent.

Plants were evaluated for the following characteristics:

- Flower number: 1 = low, 5 = very floriferous.
- Flower quality: aesthetics, color, health, and appearance.
- Foliage/plant vigor: vegetative vigor, aesthetics/color, health, and appearance.
- Plant uniformity: 1 = quality is variable from plant to plant, 5 = similar quality between all plants.
- Overall: Overall rating for all plants in the grouping, taking all the above aspects into consideration.

Results

Trial results are presented in Table 1.

The BEST of 2005:

Top Overall Season Performers in Our Plant Characteristic Evaluations

The following received the highest overall season ratings (listed in order with rankings between 5 to 4.58):

- Coleus Drop 'Strawberry'
- Coleus 'Pineapple'
- Coleus Drop 'Brown Sugar'
- Coleus Drop 'Chocolate'
- Coleus Giant 'Duckfoot'
- Coleus 'Freckles'
- Petitunia Petunia 'Happy Dream'
- Petunia Surfinia 'Lavender Lace'
- Impatiens Double Musica 'Orange Glow'
- Coleus Stained Glassworks 'Burgundy Wedding'
- Petunia Supertunia 'Vista Fuchsia'
- Scaevola 'Blue Horizon'
- Coleus 'Splash'
- Coleus Stained Glassworks 'Tabasco'
- Coleus 'Emarald & Snow'
- Coleus 'New Orleans Red'
- Impatiens Fanciful 'White'
- Scaevola Mini 'Soft Blue'
- Celosia 'Fresh Look Orange'
- Coleus 'Flame'
- Coleus 'Kiwi Fern'
- Pelargonium Zonal Americana 'Dark Red'
- Angelonia Tiger Princess
- Petunia Supertunia 'Mini Purple'
- Petunia Cascadias 'White'
- Petunia Fortunia 'White'
- Petunia 'Champagne'

- Scaevola ‘White’
- Helichrysum Helica ‘Bicolor Orange’
- Coleus ‘Sedona’
- Petunia Fortunia ‘Light Lavender’
- Petunia Cascadias ‘Bicolor Purple’
- Scaevola Whirlwind ‘Blue’

Also scoring very high (between 4.5 to 4.42) were:

- Calibrachoa Superbells ‘Peach’
- Coleus ‘Wild Lime’
- Pelargonium Zonal Avenida ‘Mosaic Red’
- Pelargonium Zonal Americana ‘Light Salmon’
- Angelonia Angelface ‘Blue Bicolor’
- Petunia Cascadias ‘Bicolor Purple’
- Petunia Sunray
- Petunia Easy Wave ‘Shell Pink Imp’
- Petunia Cascadias ‘Cherry Spark’
- Vinca Viper Pink
- Pentas Kaleidoscope ‘Apple-blossom’
- Petunia Carpet Pink ‘Morn’
- Coleus ‘Sunset’
- Verbena Donalena ‘Hot Lavender’
- Petitunia Petunia ‘Violet Dream’
- Petunia Surfinia ‘Wild Plum’
- Impatiens New Guinea 41752091
- Impatiens Candy ‘Lavender’
- Vinca Cooler ‘Red Imp’

Please note that many other entries performed very well in the trials. Entries with overall average ratings of 4.0 and above are considered as very good performers.

Field Conditions for the 2006 Trial

Based on the 2005 experience, some adjustments and improvements in bed conditions will be undertaken.

Acknowledgments

Thanks to David Cuthbert of Darby Creek Growers, Orient, Ohio, for sowing and growing the seeded entries for this year’s trial. Thank you to Bioworks for the donation of Plantshield; Dillen for the donation of plastic containers; and Kurtz Brothers, Inc., for the donation of amendments for the beds. These three companies have been contributing to the trials for several years.

We would also like to acknowledge the help of our fantastic Annuals Team of Master Gardeners — Caye Aiello, Roberta and Bill Conner, Mike Fribley, Joyce Gravlee, John Heinz, Barb House, Ken Kotch, Kathy Kranz, Marlin Languis, Denise McCall, Anne Mischo, Judy Norten, Brooke Plummer, Marilyn Stahl, Mary Straney, Juliet Taylor, and Bev Vogely. Their hard work, dedication, and expert input to this project, especially during this time of expansion, are truly appreciated and indispensable.

Thanks also to David Snodgrass, greenhouse coordinator, for his expert assistance; Mike Pfeiffer and the Mayhew Scholars for mowing and Pam Sharrett with her turf knowledge and many supplies; Mark Schmittgen and Jill Taylor for lending us their time and equipment; and to our student workers, Bobby Wilson and Krista Kamban.

Last, but certainly not least, we thank the following companies for their participation in this year’s trials:

BAKER’S ACERS
www.bakersacersgreenhouses.com

BALL SEED COMPANY
http://ballhort.com

BENARY
http://www.benary.de/

BODGER
http://www.bodger.com/

DANZINGER
http://www.danzinger.co.il

ECKE
http://www.ecke.com

FIDES
http://www.fidesplants.com

FISCHER USA
http://www.fischerusa.com

FLORANOVA
http://www.floranova.co.uk/

GRIMES
http://www.grimesseeds.com/

INTA-BALCARCE
www.inta.gov.ar/balcarce

JACKSON & PERKINS
www.surfinia.com

MCGREGOR
http://www.mcgregorplantsales.com/

PANAMERICAN SEEDS
http://www.panamseed.com

POSSUM RUN
www.possumrungreenhouse.com

PROVEN WINNERS
http://www.provenwinners.com

TWYFORD INTERNATIONAL
http://loop.phpwebhosting.com/~iepro/twyford/

Table 1. Overall Season Average, 2005.

By Overall Ratings

Genus	Series	Cultivar	Company	Source	6/15/05 Overall	7/7/05 Overall	7/27/05 Overall	9/7/05 Overall	2005 Overall
Coleus	Drop	Strawberry	Proven Winners	vegetative	N/A	5	5	5	5
Coleus		Pineapple	McGregor Plant Sales	vegetative	N/A	5	5	5	5
Coleus	Drop	Brown Sugar	Proven Winners	vegetative	N/A	4.75	5	5	4.92
Coleus	Drop	Chocolate	Proven Winners	vegetative	N/A	4.75	5	5	4.92
Coleus		Giant Duckfoot	McGregor Plant Sales	vegetative	N/A	5	5	4.75	4.92
Coleus		Freckles	McGregor Plant Sales	vegetative	N/A	5	5	4.75	4.92
Petunia	Petunia	Happy dream	Danziger Flower Farm	vegetative	N/A	4.75	5	5	4.92
Petunia	Surfinia	Lavender Lace	Jackson & Perkins	vegetative	N/A	5	4.75	5	4.92
Impatiens Double	Musica	Orange Glow	Danziger Flower Farm	vegetative	N/A	4.75	5	5	4.92
Coleus	Stained Glassworks	Burgundy Wedding	Paul Ecke Ranch	vegetative	N/A	4.5	5	5	4.83
Petunia	Supertunia	Vista Fuchsia	Proven Winners	vegetative	N/A	4.5	5	5	4.83
Scaveola		Blue Horizon	Danziger Flower Farm	vegetative	N/A	4.5	5	5	4.83
Coleus		Splash	McGregor Plant Sales	vegetative	N/A	4.75	4.75	4.75	4.75
Coleus		Tabasco	McGregor Plant Sales	vegetative	N/A	4.25	5	5	4.75
Coleus	Stained Glassworks	Emarald & Snow	Paul Ecke Ranch	vegetative	N/A	4.25	5	5	4.75
Coleus		New Orleans Red	McGregor Plant Sales	vegetative	N/A	4.5	4.75	5	4.75
Impatiens	Fanciful	White	Ball Seeds	seed	N/A	4.75	4.5	5	4.75
Scaveola	Mini	Soft Blue	Danziger Flower Farm	vegetative	N/A	4.25	5	5	4.75
Celosia		Fresh Look Orange	Benary of America	seed	N/A	5	5	4.25	4.75
Coleus		Flame	Proven Winners	vegetative	N/A	4.5	4.5	5	4.7
Coleus		Kiwi Fern	McGregor Plant Sales	vegetative	N/A	4.5	5	4.5	4.7
Pelargo-nium Zonal	Americana	Dark Red	Fischer USA/ Goldsmith	vegetative	N/A	4.75	4.75	4.5	4.7
Angelonia		Tiger Princess	McGregor Plant Sales	vegetative	N/A	5	5	4	4.7
Petunia	Supertunia	Mini Purple	Proven Winners	vegetative	N/A	4.5	4.75	4.75	4.7
Petunia	Cascadias	White	McGregor Plant Sales	vegetative	N/A	4.75	4.5	4.75	4.7
Petunia	Fortunia	White	Fides of North America	vegetative	N/A	4.75	4.5	4.75	4.7
Petunia		Champagne	Danziger Flower Farm	vegetative	N/A	4.5	4.75	4.75	4.7
Scaveola		White	Danziger Flower Farm	vegetative	N/A	4.5	4.75	4.75	4.7
Helichry-sum	Helica	Bicolor Orange	Danziger Flower Farm	vegetative	N/A	5	4.75	4	4.58
Coleus		Sedona	Proven Winners	vegetative	N/A	4.25	4.5	5	4.58

Scaveola	Whirlwind	Blue	Proven Winners	vegetative	N/A	4.75	5	4	4.58
Calibrachoa	Superbells	Peach	Proven Winners	vegetative	N/A	5	4.5	4	4.5
Coleus		Wild Lime	McGregor Plant Sales	vegetative	N/A	4.5	4.75	4.25	4.5
Pelargo-nium Zonal	Avenida	Mosaic Red	Fischer USA	vegetative	N/A	4	4.75	4.75	4.5
Pelargo-nium Zonal	Americana	Light Salmon	Fischer USA/ Goldsmith	vegetative	N/A	4.5	4.5	4.5	4.5
Angelonia	Angelface	Blue Bicolor	Proven Winners	vegetative	N/A	4.5	4.25	4.75	4.5
Petunia	Cascadias	Bicolor Purple	McGregor Plant Sales	vegetative	N/A	4	4.75	4.75	4.5
Petunia		Sunray	Danziger Flower Farm	vegetative	N/A	5	4.5	4	4.5
Petunia	Esay Wave	Shell Pink Imp	PanAmerican Seed	seed	N/A	4.5	4.5	4.5	4.5
Petunia	Cascadias	Cherry Spark	Danziger Flower Farm	vegetative	N/A	5	5	3.5	4.5
Vinca	Viper	Pink	Floranova	seed	N/A	4	5	4.5	4.5
Pentas	Kaleidoscope	Apple-blossom	Benary of America	seed	N/A	4.5	4.25	4.75	4.5
Petunia	Carpet	Pink Morn	PanAmerican Seed	seed	N/A	4.5	4.75	4	4.42
Coleus		Sunset	McGregor Plant Sales	vegetative	N/A	4.75	4	4.5	4.42
Verbena	Donalena	Hot Lavender	Danziger Flower Farm	vegetative	N/A	5	4.5	3.75	4.42
Petunia	Petunia	Violet Dream	Danziger Flower Farm	vegetative	N/A	4.5	4	4.75	4.42
Petunia	Surfinia	Wild Plum	Jackson & Perkins	vegetative	N/A	4.5	4.25	4.5	4.42
Imp. New Guinea		41752091	Fides of North America	vegetative	N/A	4.25	4.5	4.5	4.42
Impatiens	Candy	Lavender	Benary of America	seed	N/A	4	4.75	4.5	4.42
Vinca	Cooler	Red Imp	PanAmerican Seed	seed	N/A	4.75	4.5	4	4.42
Vinca	Pavifica	Really Red	PanAmerican Seed	seed	N/A	3.75	5	dead	4.38
Pelargo-nium Zonal	Eclipse	Light Salmon II	Fischer USA/ Goldsmith	vegetative	N/A	4.25	4.75	4	4.33
Marcedonia		Gold Flake	Proven Winners	vegetative	N/A	3	5	5	4.33
Dianthus	Garden Leader	Award Salmo	Grimes Seeds	seed	5	4.5	4	3.5	4.25
Helenium		Dakota Gold	PanAmerican Seed	seed	4.5	4.5	4	4	4.25
Capsicum		Black Pearl	PanAmerican Seed	seed	N/A	4	4	4.75	4.25
Verbena	Temari	Sakura Pink	Jackson & Perkins	vegetative	N/A	4.25	4	4.5	4.25
Angelonia	Angelface	Dresden Blue	Proven Winners	vegetative	N/A	5	4	3.75	4.25
Calibrachoa	Assorted	Carberry	Fides of North America	vegetative	N/A	4.5	4.75	3.5	4.25
Petunia	Fortunia	Salmon	Fides of North America	vegetative	N/A	5	4	3.75	4.25
Petunia	Petunia	Blue Dream	Danziger Flower Farm	vegetative	N/A	4.75	4	4	4.25
Petunia	Supertunia	Blush Pink	Proven Winners	vegetative	N/A	3.5	4.75	4.5	4.25

Imp. New Guinea		41756091	Fides of North America	vegetative	N/A	4.75	3.25	4.75	4.25
Vinca	Viper	Purple	Floranova	seed	N/A	4.25	5	3.5	4.25
Vinca	Viper	Red	Floranova	seed	N/A	4.5	5	3.25	4.25
Pentas	Kaleidoscope	Carmine	Benary of America	seed	N/A	3.5	4.25	5	4.25
Helichry-sum	Helica	Bicolor Lemon	Danziger Flower Farm	vegetative	N/A	4.75	4.5	3.25	4.17
Pelargo-nium Zonal	Americana	Pink III	Fischer USA/ Goldsmith	vegetative	N/A	3.75	4	4.75	4.17
Angelonia		White	McGregor Plant Sales	vegetative	N/A	4.5	4	4	4.17
Petunia	Fortunia	Trailing Pink	Fides of North America	vegetative	N/A	4.5	4.25	3.75	4.17
Petunia	Avalanche	Rose	Bodger Seeds	seed	N/A	4.5	4.75	3.25	4.17
Osteo-spermum		E-O54	Fides of North America	Greenh. Trial	N/A	4.25	3.5	4.75	4.17
Vinca	Viper	Rose	Floranova	seed	N/A	4.5	5	3	4.17
Vinca	Viper	Apricot	Floranova	seed	N/A	4.5	5	3	4.17
Pentas	Butterfly	Pink	Ball Seeds	seed	N/A	4	4.5	4	4.17
Gaura	Karalee	Dauphin	Proven Winners	vegetative	N/A	4.25	4.5	3.75	4.17
Heuchera	Dolce	Licorice	Proven Winners	vegetative	N/A	3.75	3.75	5	4.17
Heuchera	Dolce	Crème De Menthe	Proven Winners	vegetative	N/A	3.75	3.75	5	4.17
Verbena	Temari	Patio Salmon	Jackson & Perkins	vegetative	N/A	4.5	4	3.75	4.08
Angelonia	Angelface	Pink	Proven Winners	vegetative	N/A	4.5	4.25	3.5	4.08
Salvia	Evolution	Violet	Benary of America	seed	N/A	4.5	4	3.75	4.08
Petunia	Supertunia	Cotton Candy	Proven Winners	vegetative	N/A	4.75	4.75	2.75	4.08
Petunia	Wave	Rose	Fides of North America	vegetative	N/A	3.5	4.5	4.25	4.08
Imp. New Guinea		41747091	Fides of North America	vegetative	N/A	4	4	4.25	4.08
Impatiens	Candy	Apple Blossom	Benary of America	seed	N/A	3.75	4.5	4	4.08
Pelargo-nium Zonal	Americana	Rose Splash	Fischer USA/ Goldsmith	vegetative	N/A	4.5	4	3.75	4.08
Millet Ornamental		Jester	Ball Seeds	seed	N/A	4.5	4	3.5	4
Pelargo-nium Zonal	Americana	Violet	Fischer USA/ Goldsmith	vegetative	N/A	4	4.25	3.75	4
Pelargo-nium Ivy		Molina '05	Fischer USA	vegetative	N/A	4	3.75	4.25	4
Calibrachoa		Trailing Magenta	Jackson & Perkins	vegetative	N/A	4	4.5	3.5	4
Petunia	Cascadias	Blue Spark	McGregor Plant Sales	vegetative	N/A	4	4	4	4
Petunia	Garden Leader	Candypops Blue Picotee	Grimes Seeds	seed	N/A	4.25	4.25	3.5	4
Petunia	Surfinia	Patio Blue	Jackson & Perkins	vegetative	N/A	3.75	4	4.25	4
Geranium	Horizon	Red Improved	Floranova	seed	N/A	4.5	4	3.5	4
Impatiens Double	Musica	Bicolor Red	Danziger Flower Farm	vegetative	N/A	3.75	4.5	3.75	4

Begonia	Stara	Red	Floranova	seed	N/A	4	4	4	4
Helichrysum	Helica	Yellow	Danziger Flower Farm	vegetative	N/A	4.75	4.25	2.75	3.92
Pelargonium Zonal	Tango	Neon Purple	Fischer USA	vegetative	N/A	3.75	4	4	3.92
Pelargonium Interspecific	Caliente	Coral	Fischer USA/ Goldsmith	vegetative	N/A	4	4	3.75	3.92
Angelonia	Serena	White	PanAmerican Seed	seed	N/A	4.5	3.5	3.75	3.92
Calibrachoa	Superbells	Tequila Sunrise	Proven Winners	vegetative	N/A	4.75	4	3	3.92
Petunia		Choice	Danzinger	vegetative	N/A	4	3.75	4	3.92
Petunia	Avalanche	Salmon Shades	Bodger Seeds	seed	N/A	4	4.75	3	3.92
Petunia	Avalanche	Red	Bodger Seeds	seed	N/A	4.25	3.75	3.75	3.92
Petunia	Madness	Lavender Glow	Ball Seeds	seed	N/A	4	4.25	3.5	3.92
Petunia	Cascadias	Great Spark	Danziger Flower Farm	vegetative	N/A	4.5	4.5	2.75	3.92
Petunia	Cascadias	Pink	Danziger Flower Farm	vegetative	N/A	4.75	3.75	3.25	3.92
Petunia	Cascadias	Yellow Eye	Danziger Flower Farm	vegetative	N/A	3	4.25	4.5	3.92
Imp. New Guinea		41750091	Fides of North America	vegetative	N/A	3.75	4	4	3.92
Impatiens Double	Musica	Orange	Danziger Flower Farm	vegetative	N/A	4	3.75	4	3.92
Impatiens Double	Musica	Scarlet	Danziger Flower Farm	vegetative	N/A	4	3.75	4	3.92
Senecio		Kilimanjara	Fides of North America	vegetative	N/A	4	4	3.75	3.92
Millet Ornamental		Purple Baron	Ball Seeds	seed	5	4.5	3	3	3.9
Marigold	Zenith	Extra Red	Floranova	seed	4.25	4.25	4	3	3.9
Pelargonium Zonal		Alba ‘05	Fischer USA	vegetative	N/A	3.5	4	4	3.83
Calibrachoa		Lavender	Jackson & Perkins	vegetative	N/A	4	4.75	2.75	3.83
Calibrachoa	Calimor	Improved Dark Purple	McGregor Plant Sales	vegetative	N/A	3.75	4.25	3.5	3.83
Petunia	Cascadias	Yellow Eye	McGregor Plant Sales	vegetative	N/A	3.5	4	4	3.83
Petunia	Supertunia	Mini Pastel Pink	Proven Winners	vegetative	N/A	3.75	4.75	3	3.83
Petunia	Surfinia	Magenta	Jackson & Perkins	vegetative	N/A	4	4	3.5	3.83
Geranium	Horizon	Orange	Floranova	seed	N/A	4	4	3.5	3.83
Geranium	Horizon	Raspberry Ripple	Floranova	seed	N/A	4	4	3.5	3.83
Zinnia	Garden Leader	Cascade Beauty White	Grimes Seeds	seed	N/A	4.75	3.75	3	3.83
Sutera		Giant Snowflake	Proven Winners	vegetative	N/A	2.75	2	3.75	3.83
Pelargonium Zonal	Rocky Mtn.	Light Pink	Fischer USA	vegetative	N/A	2.75	3	2.75	3.83
Pelargonium Zonal	Eclipse	Dark Red	Fischer USA/ Goldsmith	vegetative	N/A	2.75	3	2.75	3.83

Torenia	Catalina	Purple	Proven Winners	vegetative	N/A	2.75	2.5	3.25	3.83
Calibrichoa	Calimor	Deep Violet	Danziger Flower Farm	vegetative	N/A	2.5	2.75	3.25	3.83
Lobelia	Fan	Salmon	Benary of America	seed	N/A	3.75	2.75	2	3.83
Torenia		White Moon	McGregor Plant Sales	vegetative	N/A	4	2.5	2	3.83
Torenia		Purple Moon	Danziger Flower Farm	vegetative	N/A	4	2	2.5	3.83
Impatiens Double	Musica	Soft Pink	Danziger Flower Farm	vegetative	N/A	3	2.75	2.75	3.83
Senecio		Himalya	Fides of North America	vegetative	N/A	2	3	3.5	3.83
Scaveola	Whirlwindä	White	Proven Winners	vegetative	N/A	3	3.5	2	3.83
Scoparia	Illumina	Lemon Mist	Jackson & Perkins	vegetative	N/A	2.75	2.75	3	3.83
Argyran-themum		Vanilla Butterfly	Proven Winners	vegetative	N/A	2.75	3	2.75	3.83
Asteriscus	Aurelia	Gold Carpet	Proven Winners	vegetative	N/A	3	2.75	2.75	3.83
Sanuitalia		Solaris	Paul Ecke Ranch	vegetative	4.5	4	2.75	3.75	3.75
Pelargo-nium Zonal	Rocky Mtn.	Violet	Fischer USA	vegetative	N/A	3.5	3.75	4	3.75
Pelargo-nium Exotic	Graffiti	Fire	Fischer USA	vegetative	N/A	4	4	3.25	3.75
Pelargo-nium Ivy	Holiday	Purple Dream	Fischer USA	vegetative	N/A	4	3.75	3.5	3.75
Pelargo-nium Ivy		Reggae Bright Red	Fischer USA	vegetative	N/A	3	3.75	4.5	3.75
Verbena	Donalena	Hot Soft Pink	Danziger Flower Farm	vegetative	N/A	5	2.75	3.5	3.75
Calibrachoa	Calimor	Brilliant Cherry	Danziger Flower Farm	vegetative	N/A	4	4.25	3	3.75
Petunia	Surfinia	Red	Jackson & Perkins	vegetative	N/A	4	3.5	3.75	3.75
Petunia	Petunia	Bright Dream	Danziger Flower Farm	vegetative	N/A	3.75	4	3.5	3.75
Petunia	Wave	Purple	Fides of North America	vegetative	N/A	3.75	3.5	4	3.75
Imp. New Guinea	Harmony	Light Orchid	Danziger Flower Farm	vegetative	N/A	4.5	3.25	3.5	3.75
Lamium		Pink Chablis	Proven Winners	vegetative	N/A	3.25	4	4	3.75
Pelargo-nium Zonal	Rocky Mtn.	Red	Fischer USA	vegetative	N/A	4	3.25	3.75	3.7
Pelargo-nium Zonal		Schoene Helena ‘06	Fischer USA	vegetative	N/A	3.75	4	3.25	3.7
Pelargo-nium Exotic	Graffiti	Salmon Rose	Fischer USA	vegetative	N/A	4	3.5	3.5	3.7
Verbena (broad Leaf)	Donalena	Violet	Danziger Flower Farm	vegetative	N/A	4.75	2.75	3.5	3.7
Angelonia	Angelface	White	Proven Winners	vegetative	N/A	4.5	3.75	2.75	3.7
Torenia		Indigo Moon	Danziger Flower Farm	vegetative	N/A	3.75	4.25	3	3.7
Calibrachoa	Assorted	Lilac	Fides of North America	vegetative	N/A	4	3.5	3.5	3.7
Calibrachoa	Calimor	Dark Pink	McGregor Plant Sales	vegetative	N/A	4.25	3.75	3	3.7

Petunia	Cascadias	Imp. Charlie	McGregor Plant Sales	vegetative	N/A	4	4	3	3.7
Petunia	Petunia	White Dream	Danziger Flower Farm	vegetative	N/A	4	4	3	3.7
Petunia	Avalanche	Lavender	Bodger Seeds	seed	N/A	4	4	3	3.7
Petunia	Cascadias	Deep Red	Danziger Flower Farm	vegetative	N/A	4.25	4	2.75	3.7
Imp. New Guinea	Harmony	Dark Lavender	Danziger Flower Farm	vegetative	N/A	4.25	3.75	3	3.7
Impatiens Double	Musica	Pearl	Danziger Flower Farm	vegetative	N/A	4.5	2.75	3.75	3.7
Lantana		Tropical Fruit	Proven Winners	vegetative	N/A	4	4.25	2.75	3.7
James-brittania	Britny	Maroon	Danziger Flower Farm	vegetative	4.5	4	3.75	2.5	3.69
Marigold	Exp. Sunburst	Yellow	Floranova	seed	4.5	4.5	3	2.75	3.69
Nicottiana	Perfume	Deep Purple	Floranova	seed	5	4.5	4	1	3.63
Sanvitalia		Sunbini	Proven Winners	vegetative	4.75	4.5	2.5	2.75	3.63
Pelargo-nium Ivy	Holiday	Rose	Fischer USA	vegetative	N/A	3.5	3.5	3.75	3.58
Pelargo-nium Inter-specific	Caliente	Rose	Fischer USA/ Goldsmith	vegetative	N/A	4	3.75	3	3.58
Verbena	Temari	Burgundy	Jackson & Perkins	vegetative	N/A	3.75	3.75	3.25	3.58
Salvia	Sahara	Red	Floranova	seed	N/A	4	3	3.75	3.58
Calibrachoa		Crackling Fire	Jackson & Perkins	vegetative	N/A	4	3.5	3.25	3.58
Petunia	Petunia	Purple Dream	Danziger Flower Farm	vegetative	N/A	4.25	3.5	3	3.58
Torenia		White Moon	Danziger Flower Farm	vegetative	N/A	4.75	3.5	2.5	3.58
Petunia	Wave	Misty Lilac	Fides of North America	vegetative	N/A	2.75	3.75	4.25	3.58
Petunia	Wave	Blue Blue Vine	Fides of North America	vegetative	N/A	3.25	3.75	3.75	3.58
Phlox	Intensia	Lavender Glow	Proven Winners	vegetative	N/A	4	3.5	3.25	3.58
Phlox	Intensia	White	Proven Winners	vegetative	N/A	4	3.75	3	3.58
Imp. New Guinea		41755091	Fides of North America	vegetative	N/A	3.75	3	4	3.58
Diascia	Genta	White	Danziger Flower Farm	vegetative	N/A	4	3.75	3	3.58
Gaura	Karalee	Pink Picotee	Proven Winners	vegetative	N/A	4.25	3.75	2.75	3.58
Dianthus	Garden Spice	White Pearl	Twyford International	vegetative	4.25	3.5	3.5	3	3.56
Marigold	Zenith	Ext.Orange	Floranova	seed	4.5	3.75	3.25	2.75	3.56
Dianthus	Garden Spice	Red	Twyford International	vegetative	3.75	3.5	3.5	3.25	3.5
Dianthus	Dynasty	Pink Magic	Ball Seeds	seed	4.75	3.75	2.75	2.75	3.5
Dianthus	Garden Spice	Fuchsia	Twyford International	vegetative	4	3.25	3.25	3.5	3.5
Laurentia		Beth's Blue	Proven Winners	vegetative	4.75	2.75	3.75	2.75	3.5
Marigold	Exp. Sunburst	Orange/Red	Floranova	seed	4.5	4	3	2.5	3.5
Marigold	Exp. Sunburst	Orange	Floranova	seed	4.5	4	3	2.5	3.5

Pelargonium Zonal		Gloria '06	Fischer USA	vegetative	N/A	3.25	3.5	3.75	3.5
Pelargonium Zonal	Americana	Deep Red	Fischer USA/ Goldsmith	vegetative	N/A	3.5	3.5	3.5	3.5
Pelargonium Ivy		Picasso	Fischer USA	vegetative	N/A	4	2.75	3.75	3.5
Verbena (broad Leaf)	Donalena	Lilac Whisper	Danziger Flower Farm	vegetative	N/A	5	2.75	2.75	3.5
Angelonia	Serena	Lavender	PanAmerican Seed	seed	N/A	4.5	3	3	3.5
Petunia	Cascadias	Bicolor Lavender	McGregor Plant Sales	vegetative	N/A	4	3.75	2.75	3.5
Petunia	Cascadias	Blue	McGregor Plant Sales	vegetative	N/A	4	3.75	2.75	3.5
Petunia	Surfinia	Patio White	Jackson & Perkins	vegetative	N/A	4	3.75	2.75	3.5
Ageratum	High Tide	Blue	PanAmerican Seed	seed	N/A	3.75	3.75	3	3.5
Imp. New Guinea	Harmony	Orange	Danziger Flower Farm	vegetative	N/A	3.25	3.75	3.5	3.5
Imp. New Guinea	Harmony	Pink Smile 267	Danziger Flower Farm	vegetative	N/A	3.5	3.25	3.75	3.5
Imp. New Guinea	Paradise	Electric Orange	Paul Ecke Ranch	vegetative	N/A	3.25	3.25	4	3.5
Impatiens Double	Musica	Red	Danziger Flower Farm	vegetative	N/A	3.5	3.5	3.5	3.5
Begonia	Lotto	Apple Blossom	Benary of America	seed	N/A	3.75	3.75	3	3.5
Pentas	Kaleidoscope	Lilac	Benary of America	seed	N/A	2.75	3	4.75	3.5
Calibrachoa	Assorted	Gold Rush	Fides of North America	vegetative	N/A	4.5	2.5	dead	3.5
Dianthus	Garden Spice	Pink	Twyford International	vegetative	4.25	3.25	3.5	2.75	3.44
Imp. New Guinea		41754091	Fides of North America	vegetative	N/A	4.25	2.75	3.25	3.42
Pelargonium Zonal	Avenida	Mosaic Purple	Fischer USA	vegetative	N/A	3.5	3.25	3.5	3.42
Pelargonium Zonal	Rocky Mtn.	Magenta	Fischer USA	vegetative	N/A	3.25	3.75	3.25	3.42
Pelargonium Ivy		Luna '05	Fischer USA	vegetative	N/A	3.75	3.75	2.75	3.42
Torenia	Summer Wave	Lavender Blue	Jackson & Perkins	vegetative	N/A	3.75	3	3.5	3.42
Calibrachoa	Calimor	Desert Shine	McGregor Plant Sales	vegetative	N/A	3.75	3.25	3.25	3.42
Torenia	Catalina	Midnight Blue	Proven Winners	vegetative	N/A	3.75	2.75	3.75	3.42
Petunia	Petunia	Bordeaux Dream	Danziger Flower Farm	vegetative	N/A	4.5	3.25	2.5	3.42
Antirrhinum	Snapa	White	Danziger Flower Farm	vegetative	N/A	4.5	3	2.75	3.42
Imp. New Guinea	Harmony	Dark Red	Danziger Flower Farm	vegetative	N/A	3.5	3.5	3.25	3.42
Imp. New Guinea		41749091	Fides of North America	vegetative	N/A	4.5	2.75	3	3.42
Impatiens Double	Musica	Dark Pink	Danziger Flower Farm	vegetative	N/A	3.75	3	3.5	3.42

Impatiens Double	Musica	Pink Energy	Danziger Flower Farm	vegetative	N/A	3.5	4	2.75	3.42
Osteo-spermum	Margarita	Rosita	Bodger Seeds	seed	N/A	4	3.75	2.5	3.42
Scaveola		Blue Haze	Danziger Flower Farm	vegetative	N/A	3.75	4	2.5	3.42
Pentas	Kaleidoscope	Deep Red	Benary of America	seed	N/A	2.5	2.75	5	3.42
Diascia	Genta	Coral	Danziger Flower Farm	vegetative	N/A	3.75	2.5	4	3.42
Euphorbia		Helena	Proven Winners	vegetative	N/A	3	3.5	3.75	3.42
Pentas	Butterfly	Lavender Shades	Ball Seeds	seed	N/A	2.75	3.25	4	3.33
Pelargo-nium Zonal	Americana	Coral	Fischer USA/ Goldsmith	vegetative	N/A	3	3.25	3.75	3.33
Pelargo-nium Zonal	Tango	Orange ‘06	Fischer USA	vegetative	N/A	3	3.25	3.75	3.33
Verbena (broad Leaf)	Donalena	Deep Pink	Danziger Flower Farm	vegetative	N/A	4.25	2	3.75	3.33
Verbena (broad Leaf)	Donalena	Pink Heart	Danziger Flower Farm	vegetative	N/A	4	3	3	3.33
Angelonia	Angelface	Blue	Proven Winners	vegetative	N/A	3.5	2.5	4	3.33
Torenia		Roslyn Moon	Danziger Flower Farm	vegetative	N/A	4	3.5	2.5	3.33
Torenia		Violet Blue Moon	Danziger Flower Farm	vegetative	N/A	4	3.5	2.5	3.33
Petunia	Avalanche	Grape	Bodger Seeds	seed	N/A	4	3	3	3.33
Petunia		Improved Charlie	Danziger Flower Farm	vegetative	N/A	2.5	4.5	3	3.33
Antirrhinum	Snapium	Sweet Yellow	Danziger Flower Farm	vegetative	N/A	3.75	3.5	2.75	3.33
Antirrhinum	Snapium	Tricolor	Danziger Flower Farm	vegetative	N/A	4.25	3	2.75	3.33
Antirrhinum	Snapium	Bordeaux	Danziger Flower Farm	vegetative	N/A	3.75	3.5	2.75	3.33
Phlox	Intensia	Neon Pink	Proven Winners	vegetative	N/A	3.75	3	3.25	3.33
Imp. New Guinea	Harmony	Magenta	Danziger Flower Farm	vegetative	N/A	3.75	3.25	3	3.33
Imp. New Guinea	Harmony	Orange Blaze	Danziger Flower Farm	vegetative	N/A	3.75	2.75	3.5	3.33
Imp. New Guinea	Harmony	Scarlet 194	Danziger Flower Farm	vegetative	N/A	3.75	2.5	3.75	3.33
Impatiens Double	Musica	Dark Salmon	Danziger Flower Farm	vegetative	N/A	3.5	3	3.5	3.33
Impatiens Double	Musica	Ruby Red	Danziger Flower Farm	vegetative	N/A	3.25	3.75	3	3.33
Osteo-spermum		OST009R	Paul Ecke Ranch	Greenh. Trial	N/A	2.75	4.5	2.75	3.33
Osteo-spermum	Margarita	Assorted	Fides of North America	vegetative	N/A	2.75	3.25	4	3.33
Diascia	Sun Chimes	Red	Paul Ecke Ranch	vegetative	N/A	3.75	2.75	3.5	3.33
Diascia	Genta	Pink	Danziger Flower Farm	vegetative	N/A	4.25	2	3.75	3.33
Gaura		White	Proven Winners	vegetative	N/A	2.5	4	3.5	3.33
Penstemon	Liliput	Pink	Proven Winners	vegetative	4.25	4	1.5	dead	3.25

Pelargonium Zonal	Rocky Mtn.	Deep Rose	Fischer USA	vegetative	N/A	3	3.75	3	3.25
Pelargonium Zonal		S.I. Orange	Fides of North America	vegetative	N/A	3.5	3.75	2.5	3.25
Pelargonium	Blizzard Cascades	Holiday-Purple-Blizzard	Fischer USA	vegetative	N/A	3.5	3.25	3	3.25
Pelargonium Ivy		Maxime	Fischer USA	vegetative	N/A	3	2.75	4	3.25
Verbena	Donalena	Purple Twinkle	Danziger Flower Farm	vegetative	N/A	3.5	2.75	3.5	3.25
Verbena (broad Leaf)	Donalena	Dark Blue	Danziger Flower Farm	vegetative	N/A	5	2	2.75	3.25
Angelonia		Blue Pacific	McGregor Plant Sales	vegetative	N/A	4	2.75	3	3.25
Calibrachoa	Colorburst	Carmine	Paul Ecke Ranch	vegetative	N/A	4.5	2.5	2.75	3.25
Torenia		Blue Moon	Danziger Flower Farm	vegetative	N/A	3.5	3.5	2.75	3.25
Petunia	Petunia	Scarlet Dream	Danziger Flower Farm	vegetative	N/A	3	3.5	3.25	3.25
Petunia	Avalanche	Pink	Bodger Seeds	seed	N/A	3.75	3.5	2.5	3.25
Petunia	Madness	Rose Morn	Ball Seeds	seed	N/A	3.75	4	2	3.25
Antirrhinum	Snapium	Rustic Orange	Danziger Flower Farm	vegetative	N/A	3.5	3.5	2.75	3.25
Antirrhinum	Snapa	Lemon	Danziger Flower Farm	vegetative	N/A	3.75	2.5	3.5	3.25
Imp. New Guinea	Exp. Divine	Mix	Ball Seeds	seed	N/A	4	2.75	3	3.25
Imp. New Guinea	Harmony	Dark Violet	Danziger Flower Farm	vegetative	N/A	3.25	3.25	3.25	3.25
Imp. New Guinea	Paradise	Salmon (grenada)	Paul Ecke Ranch	vegetative	N/A	3.5	3	3.25	3.25
Imp. New Guinea		41757091	Fides of North America	vegetative	N/A	4	3	2.75	3.25
Impatients	Garden Leader	Logro Pink	Grimes Seeds	seed	N/A	3	3	3.75	3.25
Osteospermum	Soprano	Compact Purple	Proven Winners	vegetative	N/A	4	2.75	3	3.25
Osteospermum	Margarita	Maria	Bodger Seeds	seed	N/A	4	3	2.75	3.25
Diascia	Genta	Dark Coral	Danziger Flower Farm	vegetative	N/A	4	3	2.75	3.25
Diascia	Genta	Salmon	Danziger Flower Farm	vegetative	N/A	4.5	1.25	4	3.25
Lavender		Lavance	Ball Seeds	seed	N/A	3.75	2.75	dead	3.25
Portulaca	Tequila	Cherry	PanAmerican Seed	seed	4.75	4.25	2.75	1	3.19
Marigold	Zenith	Ext. Lemonyellow	Floranova	seed	3.75	4	2.25	2.75	3.19
Pelargonium Zonal	Rocky Mtn.	Coral	Fischer USA	vegetative	N/A	3.25	3.25	3	3.17
Pelargonium		Ruby Dream	Fischer USA	vegetative	N/A	3	2.75	3.75	3.17
Pelargonium Ivy		Tutti Frutti	Fischer USA	vegetative	N/A	3	3.25	3.25	3.17

Verbena (broad Leaf)	Donalena	Purple Blue	Danziger Flower Farm	vegetative	N/A	4	2.75	2.75	3.17
Verbena (broad Leaf)	Donalena	White Hail	Danziger Flower Farm	vegetative	N/A	3.5	2.75	3.25	3.17
Calibrichoa	Calimor	Violet Blue	Danziger Flower Farm	vegetative	N/A	3.75	3	2.75	3.17
Calibrachoa	Assorted	Scarlet Red	Fides of North America	vegetative	N/A	3.75	3	2.75	3.17
Petunia	Fortunia	Blue Vine	Fides of North America	vegetative	N/A	4.5	3	2	3.17
Torenia		Pink Moon	Danziger Flower Farm	vegetative	N/A	4.25	2.75	2.5	3.17
Petunia	Rapide	Purple	Floranova	seed	N/A	3.5	3.25	2.75	3.17
Antirrhinum	Snapium	Pink	Danziger Flower Farm	vegetative	N/A	3.75	3	2.75	3.17
Imp. New Guinea	Paradise	Deep Pink	Paul Ecke Ranch	vegetative	N/A	4	2.75	2.75	3.17
Imp. New Guinea		41753091	Fides of North America	vegetative	N/A	4	2.75	2.75	3.17
Osteo-spermum		E-O97	Fides of North America	Greenh. Trial	N/A	4	2.75	2.75	3.17
Osteo-spermum	Margarita	Rosita	Fides of North America	Greenh. Trial	N/A	3.25	3.5	2.75	3.17
Petunia	Petunia	Yellow Dream	Danziger Flower Farm	vegetative	N/A	3.5	2.75	dead	3.13
Petunia	Cascadias	Purple	McGregor Plant Sales	vegetative	N/A	3.5	2.75	3	3.08
Petunia	Cascadias	Lime	Danziger Flower Farm	vegetative	N/A	3.75	2.75	2.75	3.08
Convol-vulus		Blue Casbah	Proven Winners	vegetative	N/A	3.75	2.75	2.75	3.08
Pelargo-nium Zonal	Americana	Light Pink Splash II	Fischer USA/ Goldsmith	vegetative	N/A	4	3	2.25	3.08
Pelargo-nium Exotic	Graffiti	Pink	Fischer USA	vegetative	N/A	3.5	2.75	3	3.08
Calibrachoa	Superbells	Plum	Proven Winners	vegetative	N/A	4.5	2.75	2	3.08
Calibrachoa	Colorburst	Pro Rose	Paul Ecke Ranch	vegetative	N/A	4	2.5	2.75	3.08
Calibrichoa	Calimor	Dark Pink	Danziger Flower Farm	vegetative	N/A	3	3.25	3	3.08
Veronica	Garden Leader	Light Blue	Grimes Seeds	seed	N/A	2.5	4	2.75	3.08
Petunia	Frillytunia	Burgundy	Floranova	seed	N/A	3.5	3.25	2.5	3.08
Petunia	Avalanche	White	Bodger Seeds	seed	N/A	3.5	2.75	3	3.08
Torenia		Punky Violet	Danziger Flower Farm	vegetative	N/A	4.5	2.25	2.5	3.08
Imp. New Guinea	Harmony	Peach	Danziger Flower Farm	vegetative	N/A	3	2.75	3.5	3.08
Imp. New Guinea	Tamarinda	True Pink	Fides of North America	vegetative	N/A	2	2.75	4.5	3.08
Imp. New Guinea	Tamarinda	Light Violet	Fides of North America	vegetative	N/A	3.75	2.75	2.75	3.08
Imp. New Guinea	Paradise	White Improved	Paul Ecke Ranch	vegetative	N/A	3.5	3	2.75	3.08
Imp. New Guinea	Tamarinda	Dark Salmon	Fides of North America	vegetative	N/A	4	2.75	2.5	3.08

Osteo-spermum		OST018R	Paul Ecke Ranch	Greenh. Trial	N/A	2.75	4	2.5	3.08
Argyran-themum	Angelic	Purple	Danziger Flower Farm	vegetative	N/A	2.75	2.75	3.75	3.08
Leucan-themum		Broadway Lights	Proven Winners	vegetative	N/A	2.5	3.75	3	3.08
Biddens		Yellow Glow	Danziger Flower Farm	vegetative	N/A	3.58	2.75	2.75	3.03
Sutera	Snowstorm	Pink	Proven Winners	vegetative	N/A	2.75	2.5	3.75	3
Sutera	Glacier	Blue	Proven Winners	vegetative	N/A	2.75	2	4.25	3
Pelargo-nium Zonal	Rocky Mtn.	Salmon Rose	Fischer USA	vegetative	N/A	3	3.25	2.75	3
Pelargo-nium Zonal	Rocky Mtn.	White ‘06	Fischer USA	vegetative	N/A	3.25	2.75	3	3
Pelargo-nium Ivy	Holiday	Ruby Dream	Fischer USA	vegetative	N/A	2.75	2.75	3.5	3
Stachys		Sentimental Journey	Proven Winners	vegetative	N/A	3	3.25	2.75	3
Verbena	Tapien	Lilac	Jackson & Perkins	vegetative	N/A	3.75	2	3.25	3
Verbena	Donalena	Hot Red	Danziger Flower Farm	vegetative	N/A	2.75	2.75	3.5	3
Torenia		Rose Moon	Danziger Flower Farm	vegetative	N/A	3.25	2.75	3	3
Torenia		Blue Moon	McGregor Plant Sales	vegetative	N/A	3.75	2.75	2.5	3
Petunia	Rapide	Red	Floranova	seed	N/A	3.5	4	1.5	3
Antirrhinum	Snapium	Dark Pink	Danziger Flower Farm	vegetative	N/A	3.5	2.75	2.75	3
Antirrhinum	Snapa	Rustic Red	Danziger Flower Farm	vegetative	N/A	2.5	3.5	3	3
Impatiens Double	Musica	Pink	Danziger Flower Farm	vegetative	N/A	3.5	2.75	2.75	3
Osteo-spermum		OST030R	Paul Ecke Ranch	Greenh. Trial	N/A	2	3	4	3
Pulmonaria	Gaelic	Spring	Proven Winners	vegetative	N/A	3	3	3	3
Pelargo-nium Zonal	Rocky Mtn.	Dark Red	Fischer USA	vegetative	N/A	2.75	3	3	2.92
Pelargo-nium Zonal	Tango	Fire	Fischer USA	vegetative	N/A	3	3	2.75	2.92
Verbena (broad Leaf)	Donalena	Crimson	Danziger Flower Farm	vegetative	N/A	4	2	2.75	2.92
Verbena (broad Leaf)	Donalena	Magenta	Danziger Flower Farm	vegetative	N/A	4	1.75	3	2.92
Verbena (broad Leaf)	Donalena	Purple Red	Danziger Flower Farm	vegetative	N/A	3.75	2	3	2.92
Torenia	Clown	Rose Imp	PanAmerican Seed	seed	N/A	3.25	2.75	2.75	2.92
Torenia	Clown	Burgundy Imp	PanAmerican Seed	seed	N/A	3.25	2.75	2.75	2.92
Calibrachoa	Calimor	White	McGregor Plant Sales	vegetative	N/A	2.75	3.25	2.75	2.92
Torenia	Catalina	Blue	Proven Winners	vegetative	N/A	3	2.75	3	2.92
Petunia	Avalanche	Tropical Red	Bodger Seeds	seed	N/A	4	3.5	1.25	2.92
Torenia		Purple Moon	McGregor Plant Sales	vegetative	N/A	3.5	2.75	2.5	2.92

Imp. New Guinea	Harmony	Rasberry Cream	Danziger Flower Farm	vegetative	N/A	3.25	2.75	2.75	2.92
Diascia	Flying Colors	Red	Proven Winners	vegetative	N/A	2.75	3	3	2.92
Diascia	Genta	Orange	Danziger Flower Farm	vegetative	N/A	4.5	2.75	1.5	2.92
Torenia		Honey Moon	McGregor Plant Sales	vegetative	N/A	3.5	2.75	2.5	2.92
Oenothera		Lemon Drop	Proven Winners	vegetative	4	3.25	1.5	2.5	2.81
Bacopa	Golden Leaves	White	Danziger Flower Farm	vegetative	N/A	2.5	2.75	3	2.75
Bacopa	Copia	Improved Great White	Danziger Flower Farm	vegetative	N/A	3.25	2	3	2.75
Pelargo-nium Ivy		Flair	Fischer USA	vegetative	N/A	2.75	2.75	2.75	2.75
Calibrachoa	Assorted	Cherry Rose	Fides of North America	vegetative	N/A	3.5	2.75	2	2.75
Petunia	Cascadias	Vivid Red (Scarlet)	McGregor Plant Sales	vegetative	N/A	3	2.5	2.75	2.75
Lobelia	Laguna	Sky Blue	Proven Winners	vegetative	N/A	3.75	2	2.5	2.75
Antirrhinum	Snapa	Margenta	Danziger Flower Farm	vegetative	N/A	2.75	2.5	3	2.75
Antirrhinum	Snapa	Bicolor Pink	Danziger Flower Farm	vegetative	N/A	3.25	2	3	2.75
Osteo-spermum		OST031R	Paul Ecke Ranch	Greenh. Trial	N/A	2.75	2.75	2.75	2.75
Osteo-spermum		OST010R	Paul Ecke Ranch	Greenh. Trial	N/A	2.75	3	2.5	2.75
Bacopa	Copia	Great Pink Shade	Danziger Flower Farm	vegetative	N/A	2.5	1.75	3.75	2.7
Pelargo-nium Zonal	Americana	Confetti Red	Fischer USA/ Goldsmith	vegetative	N/A	2.5	2.5	3	2.7
Pel.	Blizzard Cascades	Holiday-Red-Blizzard	Fischer USA	vegetative	N/A	3	2.25	2.75	2.7
Verbena (narrow Leaf)	Veralena	Lavender Moment	Danziger Flower Farm	vegetative	N/A	3	2.5	2.5	2.7
Torenia	Catalina	Pink	Proven Winners	vegetative	N/A	2.75	2.5	2.75	2.7
Calibrachoa	Calimor	Dark Red	McGregor Plant Sales	vegetative	N/A	3.75	2.5	1.75	2.7
Petunia	Garden Leader	Leader Lorgo Mix	Grimes Seeds	seed	N/A	2.75	2.5	2.75	2.7
Torenia		Violet Moon	McGregor Plant Sales	vegetative	N/A	4	2	2	2.7
Imp. New Guinea	Infinity	Crimson	Proven Winners	vegetative	N/A	2.75	2.75	2.5	2.7
Anagallis		Orange	Proven Winners	vegetative	N/A	3.75	2	2	2.58
Sutera	Cabana	Trailing Blue	Proven Winners	vegetative	N/A	2.75	2	3	2.58
Sutera	Snowstorm	Blue Ice	Proven Winners	vegetative	N/A	2.75	2	3	2.58
Bacopa	Copia	Sunshine Blue	Danziger Flower Farm	vegetative	N/A	2.5	2	3.25	2.58
Pelargo-nium Inter-specific	Caliente	Deep Red	Fischer USA/ Goldsmith	vegetative	N/A	3.75	2	2	2.58

Pelargo-nium Ivy	Freestyle	Artic Red	Fischer USA/ Goldsmith	vegetative	N/A	3.5	2.75	1.5	2.58
Calibrachoa	Colorburst	Pro Red	Paul Ecke Ranch	vegetative	N/A	3.75	2.5	1.5	2.58
Antirrhinum	Snapa	Dark Magenta	Danziger Flower Farm	vegetative	N/A	2	3	2.75	2.58
Nemesia	Sunsatia	Mango	Proven Winners	vegetative	N/A	3.75	2.75	1.25	2.58
Osteo-spermum	Margarita	Maria	Fides of North America	Greenh. Trial	N/A	2	2.75	3	2.58
Osteo-spermum	Margarita	Carmen	Fides of North America	vegetative	N/A	2.25	2.75	2.75	2.58
Diascia	Genta	Antique Red	Danziger Flower Farm	vegetative	N/A	3	2.75	2	2.58
Gaura		Pink Fountain	Paul Ecke Ranch	vegetative	N/A	2	3	2.75	2.58
Aniso-dentea		Little Lady	Proven Winners	vegetative	N/A	2.75	2	3	2.58
Coleus		Rustic Orange	McGregor Plant Sales	vegetative	N/A	2.5	2.5	2.5	2.5
Verbena (narrow Leaf)	Veralena	Magenta	Danziger Flower Farm	vegetative	N/A	3.5	2.5	1.5	2.5
Torenia		Pink Moon	McGregor Plant Sales	vegetative	N/A	3.5	2	2	2.5
Antirrhinum	Snapa	Gold	Danziger Flower Farm	vegetative	N/A	2.75	2	2.75	2.5
Imp. New Guinea	Harmony	Salmon	Danziger Flower Farm	vegetative	N/A	2.5	2	3	2.5
Imp. New Guinea	Harmony	White	Danziger Flower Farm	vegetative	N/A	2.75	2	2.75	2.5
Osteo-spermum	Margarita	Carmen	Fides of North America	Greenh. Trial	N/A	2.5	3	2	2.5
Bacopa	Gulliver	White	Danziger Flower Farm	vegetative	N/A	2	2	3.25	2.42
Bacopa	Copia	Dark Pink	Danziger Flower Farm	vegetative	N/A	2.5	2	2.75	2.42
Verbena (narrow Leaf)	Veralena	Timless Pink	Danziger Flower Farm	vegetative	N/A	3.25	2	2	2.42
Calibrachoa	Calimor	Midnight Blue	McGregor Plant Sales	vegetative	N/A	2.75	2.5	2	2.42
Gazania			Benary of America	seed	N/A	2.5	2.75	2	2.42
Imp. New Guinea	Infinity	Ruby Flush	Proven Winners	vegetative	N/A	2.75	2.5	2	2.42
Impatiens Double	Musica	White Blush	Danziger Flower Farm	vegetative	N/A	2.75	2.5	2	2.42
Osteo-spermum	Exp.	Light Purple	Proven Winners	vegetative	N/A	4.5	1.75	1	2.42
Argyran-themum	Angelic	Pink Silk	Danziger Flower Farm	vegetative	N/A	2.5	2	2.75	2.42
Diascia	Genta	Apple Blossom	Danziger Flower Farm	vegetative	N/A	3.5	1.25	2.5	2.42
Verbena (broad Leaf)	Donalena	Red Pepper	Danziger Flower Farm	vegetative	N/A	2.5	2	2.5	2.33
Verbena (narrow Leaf)	Veralena	Purple	Danziger Flower Farm	vegetative	N/A	3	2.5	1.5	2.33

Calibrichoa	Calimor	White	Danziger Flower Farm	vegetative	N/A	3	2	2	2.33
Dahlia	Garden Leader	Caruso Purple	Grimes Seeds	seed	N/A	2.5	2	2.5	2.33
Scabiosa		Ritz Blue	Benary of America	seed	N/A	2.75	2.75	1.5	2.33
Argyran-themum	Summersong	Rose	Paul Ecke Ranch	vegetative	N/A	2	2.5	2.5	2.33
Argyran-themum	Angelic	Blush	Danziger Flower Farm	vegetative	N/A	3.25	2	1.75	2.33
Bacopa	Gulliver	Lavender	Danziger Flower Farm	vegetative	N/A	2	2	2.75	2.25
Bacopa	Copia	Great Lavender	Danziger Flower Farm	vegetative	N/A	2.5	1.75	2.5	2.25
Bacopa	Copia	Great Blue	Danziger Flower Farm	vegetative	N/A	3	1.25	2.5	2.25
Calibrichoa	Calimor	Wild Purple	Danziger Flower Farm	vegetative	N/A	3.75	1.5	1.5	2.25
Lobelia	Garden Leader	Coat of Arms Light Blue	Grimes Seeds	seed	N/A	3.75	1.5	1.5	2.25
Petunia	Petunia	Sweet Dream	Danziger Flower Farm	vegetative	N/A	2	2	2.75	2.25
Calli-stephus	Hulk	Green	Benary of America	seed	N/A	2.75	1.75	dead	2.25
Lobelia	Laguna	White	Proven Winners	vegetative	N/A	3	2	1.5	2.17
Calibrachoa	Assorted	Deep Yellow	Fides of North America	vegetative	N/A	3	2	1.5	2.17
Dahlia	Garden Leader	Wine	Grimes Seeds	seed	N/A	2.5	1.5	2.5	2.17
Osteo-spermum		OST021R	Paul Ecke Ranch	Greenh. Trial	N/A	1.5	2.5	2.5	2.17
Argyran-themum	Angelic	Neptune	Danziger Flower Farm	vegetative	N/A	3	1	2.5	2.17
Argyran-themum	Molimba	First Blush	Proven Winners	vegetative	N/A	2.5	2	2	2.17
Calibrichoa	Calimor	Desert Shine	Danziger Flower Farm	vegetative	N/A	2.5	1.75	2	2.08
Calibrachoa	Calimor	Yellow	McGregor Plant Sales	vegetative	N/A	1.5	2	2.75	2.08
Antirrhinum	Snapium	Antique Pink	Danziger Flower Farm	vegetative	N/A	1.25	2	3	2.08
Antirrhinum	Snapa	Pink	Danziger Flower Farm	vegetative	N/A	1.25	2	3	2.08
Osteo-spermum	Symphony	Melon	Proven Winners	vegetative	N/A	3.75	1.5	1	2.08
Calibrachoa	Calimor	Indian Summer	McGregor Plant Sales	vegetative	N/A	2	2	2	2
Calibrichoa	Calimor	Midnight Blue	Danziger Flower Farm	vegetative	N/A	2.5	2	1.5	2
Argyran-themum	Angelic	Dark Pink	Danziger Flower Farm	vegetative	N/A	3	1	2	2
Calibrichoa	Calimor	Dark Red	Danziger Flower Farm	vegetative	N/A	2.5	2	1.25	1.92
Osteo-spermum		OST037R	Paul Ecke Ranch	Greenh. Trial	N/A	1.5	2	2	1.83
Argyran-themum	Angelic	Pink Delight	Danziger Flower Farm	vegetative	N/A	2.75	1	1.75	1.83

Nemesia	Sunsatia	Rasberry	Proven Winners	vegetative	N/A	2.5	2	1	1.83
Nema-tanthus			Fides of North America	vegetative	N/A	1	2	2.25	1.75
Biddens		Yellow Fire	Danziger Flower Farm	vegetative	N/A	2.5	1.5	1.25	1.75
Salvia		Strata	Floranova	seed	N/A	1.5	1.5	2	1.7
Sedum	Garden Leader	Gold Carpet	Grimes Seeds	seed	N/A	2	2	1	1.7
Oxalis		Lucky	Paul Ecke Ranch	vegetative	N/A	2	1.5	1.25	1.58
Argyran-themum	Summersong	White	Paul Ecke Ranch	vegetative	N/A	2	1.25	1.5	1.58
Argyran-themum	Angelic	Burgendy	Danziger Flower Farm	vegetative	N/A	2.75	1	1	1.58
Helianthus		LBO 300	INTA-Balcarce-Balcarce	seed	N/A	N/A	4.5	N/A	1.5
Helianthus		LBO 100	INTA-Balcarce-Balcarce	seed	N/A	N/A	4	N/A	1.3
Helianthus		LBO 600	INTA-Balcarce-Balcarce	seed	N/A	N/A	3.75	N/A	1.25
Helianthus		LBO 500	INTA-Balcarce-Balcarce	seed	N/A	N/A	3.5	N/A	1.16
Helianthus		LBO 200	INTA-Balcarce-Balcarce	seed	N/A	N/A	3.25	N/A	1.08
dead = All or most of the plants were dead at the time of evaluation									
N/A = not avaliable at the time of evaluation									
Greenh. Trial = Plants from the greenhouse trial were trialed with the summer annuals									

~ 13 ~
A Collection of Crabapple Knowledge from Secrest Arboretum: 1993–2005

Erik A. Draper, James A. Chatfield and Kenneth D. Cochran

Introduction

Crabapples are very diverse in their ornamental offerings for enhancing landscapes. It is this versatility and durability that allow crabapples to create specific effects or impacts for landscape settings.

Crabapples come in a variety of tree forms, which not only provide shade but also add a foliage accent to complement the garden retreat. Bud and flower colors create a welcome treat in the spring. The fruit effect develops as the fruit ripens and persists as long as the colored fruit clings to the branches.

In order to select the proper tree for the emphasis or desired effect, a profile of total aesthetics for each crabapple is necessary. Total aesthetics includes the impact or effect of diseases, insects, fruit, flowers, foliage, tree form, and growth rate upon each crabapple selection.

Forty-three crabapple taxa (original Crablandia plot) growing at the Secrest Arboretum on The Ohio State University's Ohio Agricultural Research and Development Center Wooster, Ohio, campus, were evaluated monthly from August 1993 to August 2000. An additional 14 crabapple taxa were added and evaluated from August 1997 to August 2000. A new Crablandia II plot at Secrest Arboretum, which presently includes 77 taxa, was established in 1998, and evaluations began in June 2001.

The results of these evaluations are presented in this report, which is intended for use by nurseries, garden centers, landscape architects, landscapers, and homeowners. This information can assist in providing an accurate depiction of each tree's response to the specific growing conditions of Ohio.

Materials and Methods

The original crabapple research plot, designated as Crablandia, was located at Secrest Arboretum, in Wooster, Ohio. The plot was a completely randomized design with three single plant replicates of each taxon.

This National Crabapple Evaluation Plot (NCEP), planted in 1984, contained 46 crabapple taxa. Observations and data were collected on each of these 46 taxa. However, due to disease, attrition, and repeatedly poor performance, some crabapple selections were culled in 1998.

Erik A. Draper, Ohio State University Extension, Geauga County; James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science; and Kenneth D. Cochran, Secrest Arboretum, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, Ohio.

The remaining 28 crabapple taxa provided data from August 1993 to August 2000.

An additional 14 crabapple selections were interplanted into the original NCEP plot in 1994 and rated from August 1997 to August 2000 only. These 14 newly selected taxa provided insights, observations, and incentives to create another new plot with the latest crabapple releases available from nurseries.

A second crabapple research plot, designated as Crablandia II, was initiated in 1998 at Secrest Arboretum. It began with 58 selected crabapple taxa and currently contains 77 taxa being evaluated. This plot consists of a completely randomized design, with five single plant replicates of each taxon. Planting of the latest selections or new releases will be an ongoing process. Research evaluations and data collection began June 2001.

Fruit color and size, bloom color, tree form, incidence of scab, and mature tree size are reported in Table 1. Fruit color and size, bloom color, and tree form were from observations reported from our NCEP plots (4). These findings were cross referenced with observations recorded by the late crabapple hybridizer, Father John Fiala (6) and other researchers (2).

Apple scab susceptibility ratings and observations were recorded yearly, during the months of June through August; those findings were compiled for this report.

Table 2 provides the time of effective fruit display, overall mature tree size, and an expanded description or profile of each crabapple taxon. These profiles offer the positive and negative aspects of aesthetics and disease observations, according to the evaluations of the authors (3, 5). The time of effective fruit display was compiled from observations conducted each month during the year. The overall disease observations were compiled from findings noted and reported by the authors in other articles written for previous publications of this ornamental research circular (1).

Results and Discussion

The 2005 growing season was difficult because of weather extremes. Spring rains were abundant; however, early on the rains stopped and hot, dry, windy weather prevailed throughout most of the growing season.

Crabapples were initially challenged by apple scab (Venturia inaequalis) in the spring; but, dry, hot conditions rapidly slowed development. Perfect spring weather conditions caused most flowers to emerge unscathed by frost, and consequently, most flowers set fruit. The result was a spectacular year for both bloom and fruit in 2005.

Fireblight (Erwinia amylovora) struck again this year; however, trees were minimally affected because of the cooler temperatures during most of the bloom period. Another disease, frogeye leaf spot (Botryosphaeria obtusa) also caused a slight defoliation on many of the taxa.

Table 1. Fruit Color, Fruit Size, Bloom Color, Tree Form, Scab Rating, and Mature Tree Size of Crabapples at Secrest Arboretum.

Crabapple	Fruit Color[1]	Fruit Size (Inches)	Bloom Color[2]	Tree Form[3]	Scab Rating[4]	Mature Tree Size[5]
'Adams'	MR	0.5-0.75	DP	MS	major	20
'Adirondack'	OR	0.4-0.6	W	NU	none	15
'American Masterpiece'	YO	0.3-0.5	RP	BR	major	18
'American Salute'	RO	0.3-0.5	RoPu	US	minor	28
'American Spirit'	MR	0.4-0.5	RoP	BR	major	18
'American Triumph'	M	0.3-0.4	RoP	BR	major	18
Malus baccata 'Jackii'	MR	0.4-0.5	W	BR	none	25
'Beverly'	RoR	0.5-0.75	W	BS	none	20
'Bob White'	GY	0.4-0.5	W	BR	trace	20
'Brandywine'	YGr	1- 1.5	DP(db)	MS	minor	20
'Callaway'	CR	0.75- 1.2	W	MS	none	18
M. zumi 'Calocarpa'	DR	0.3-0.4	W	MS	trace	15
'Camelot'	RoP	0.3-0.4	W	DR	trace	10
'Canary'	Y	0.25-0.4	W	UO	minor	18
'Candymint'	RPu	0.25-0.4	RoP	LS	trace	8
'Canterbury'	RoP	0.25-0.4	P	DR	none	10
'Centurion'	CR	0.4-0.6	RoR	US	major	20
'Cinderella'	GY	0.2-0.3	W	DR	trace	6
'Coralburst'	YGr	0.2-0.3	CoP (db)	R	minor	15
'David'	CR	0.5-0.6	W	R	trace	15
'Dolgo'	RPu	1- 1.5	W	MS	none	18
'Donald Wyman'	R	0.4-0.5	W	BR	minor	25
'Doubloons'	LG	0.4-0.5	W(db)	R	minor	12
'Excalibur'	GY	0.2-0.3	W	DR	none	10
'Firebird'	RO	0.2-0.3	W	DU	none	10
M. floribunda	Y	0.3-0.4	W	BR	minor	15
'Foxfire'	CR	0.5-0.6	W	BR	none	15
'Glen Mills/Winter Gem'	R	0.2-0.3	W	OV	major	18
'Golden Raindrops'	Y	0.2-0.3	W	OS	none	22
'Guinevere'	CR	0.5-0.6	W	DO	trace	8
'Hamlet'	MR	0.4-0.5	W	DM	none	10
'Harvest Gold'	Y	0.3-0.4	W	BR	major	20
'Henningii'	RO	0.5-0.6	W	UO	major	25
'Holiday Gold'	GY	0.4-0.5	W	OS	none	18
M. adstringens 'Hopa'	R	0.6-0.8	RoR	US	major	25
'Indian Magic'	OR	0.3-0.4	RoP	MS	major	15
'Indian Summer'	R	0.5-0.6	RoR	BR	major	18
'Jewelberry'	RO	0.3-0.4	W	DB	major	8
'King Arthur'	RoR	0.5-0.6	W	DM	none	12

Table 1 (continued). Fruit Color, Fruit Size, Bloom Color, Tree Form, Scab Rating, and Mature Tree Size of Crabapples at Secrest Arboretum.						
Crabapple	**Fruit Color[1]**	**Fruit Size (Inches)**	**Bloom Color[2]**	**Tree Form[3]**	**Scab Rating[4]**	**Mature Tree Size[5]**
'King Arthur'	RoR	0.5-0.6	W	DM	none	12
'Lancelot'	Y	0.2-0.3	W	DU	none	10
'Lollipop'	RO	0.2-0.3	W	DR	none	8
'Liset'	MR	0.5-0.6	RoR	OR	trace	15
'Louisa'	LG	0.3-0.4	P	TW	none	15
'Madonna'	BrR	0.4-0.5	W(db)	US	major	20
'Manbeck's Weeper'	CR	0.3-0.4	W	SW	minor	8
'Mary Potter'	R	0.3-0.4	W	OS	trace	10
'Molten Lava'	RO	0.3-0.4	W	MS	minor	15
'Narrangansett'	CR	0.4-0.5	W	MS	major	12
'Ormiston Roy'	OY	0.3-0.4	W	BR	trace	20
M. halliana 'Parkmanii'	Y	0.3-0.4	W	BR	minor	15
'Pink Princess'	MR	0.2-0.3	RoP	DM	trace	8
'Pink Satin'	DR	0.3-0.4	P	UO	major	12
'Prairie Maid'	RoR	0.3-0.4	DP	BS	none	10
'Prairifire'	RPu	0.4-0.5	CoR	OR	trace	18
'Professor Sprenger'	OR	0.5-0.6	W	MS	minor	20
'Profusion'	MR	0.4-0.5	RPu	US	major	22
'Purple Prince'	BPu	0.4-0.5	RoR	BR	trace	15
'Radiant'	RPu	0.4-0.5	DP	MS	major	25
'Ralph Shay'	R	1.3- 1.5	W	BS	major	10
'Rawhide'	R	1.2- 1.5	W	NU	none	18
'Red Barron'	DR	0.5-0.6	RP	US	major	18
'Red Jade'	R	0.4-0.5	W	SW	minor	12
'Red Jewel'	CR	0.3-0.4	W	OV	trace	15
'Red Splendor'	R	0.5-0.6	RoP	US	major	20
'Red Swan'	R	0.2-0.3	WhP	TW	trace	10
'Robinson'	DR	0.5-0.6	RoPu	MS	major	25
'Royal Fountain'	MR	0.2-0.3	RoP	TW	minor	10
'Royal Scepter'	CR	0.5-0.6	RoP(db)	US	major	18
'Royalty'	DR	0.5-0.6	RPu	MS	major	20
'Ruby Luster'	RoR	1.5- 1.7	RoP	BR	major	28
M. sargentii	R	0.2-0.3	W	LS	none	8
'Selkirk'	CR	0.9- 1.0	RoR	BR	major	20
'Sentinel'	R	0.3-0.4	W	US	minor	18
'Silver Drift'	CR	0.3-0.4	W	OV	minor	20
'Silver Moon'	RPu	0.3-0.4	W	MS	none	20
'Sinai Fire'	RO	0.4-0.5	W	OS	none	15
'Snowdrift'	SR	0.3-0.4	W	BR	major	20

Table 1 (continued). Fruit Color, Fruit Size, Bloom Color, Tree Form, Scab Rating, and Mature Tree Size of Crabapples at Secrest Arboretum.

Crabapple	Fruit Color[1]	Fruit Size (Inches)	Bloom Color[2]	Tree Form[3]	Scab Rating[4]	Mature Tree Size[5]
'Spring Snow'	No Fruit	W	OV	major	25	
'Strawberry Parfait'	R	0.4-0.5	P	OS	trace	18
'Sugar Tyme'	CR	0.4-0.5	W	MS	minor	18
'Thunderchild'	BPu	0.3-0.4	RoR	OV	major	15
M. sargentii 'Tina'	RPu	0.2-0.3	W	LS	none	5
M. tschonoskii	YGr	1- 1.2	W	PY	none	35
'Velvet Pillar'	MR	0.4-0.5	P	US	major	20
'Weeping Candied Apple'	R	0.4-0.5	RoP	OS	major	15
'White Angel'	R	0.5-0.6	W	BR	none	20
'White Cascade'	YGr	0.3-.4	W	TW	major	15
'Winter Gold'	LG	0.3-0.4	W	UO	major	25

[1] **Fruit Color Key:** BPu: blue-purple, BrR: brown-red, CoR: coral-red, CR: cherry-red, DP: deep pink, DR: dark red, G: gold, GY: golden-yellow, LG: lemon-gold, M: maroon, MR: maroon-red, O: orange, OR: orange-red, OY: orange-yellow, P: pink, Pu: purple, R: red, RO: red-orange, RPu: red-purple, Ro: rose, RoR: rose-red, SR: salmon red, Y: yellow, YGr: yellow-green.

[2] **Bloom Color Key:** (db) signifies that the bloom is a double flower; CoR: coral-red, CoP: coral-pink, P: pink, DP: deep pink, R: red, RP: red-pink, RPu: red-purple, Ro: rose, RoP: rose-pink, RoR: rose-red, RoPu: rose-purple, W: white, WhP: white-pink.

[3] **Tree Form:** BR: broadly rounded, BS: broadly spreading, DR: dwarf rounded, DB: dwarf broadly rounded, DM: dwarf mounded spreading, DO: dwarf open spreading, DU: dwarf upright spreading, LS: low spreading, MS: mounded spreading, NU: narrow upright, OS: open spreading, OR: open rounded, OV: oval, R: rounded, SW: spreading weeper, TW: true weeper, UO: upright open, US: upright spreading.

[4] Scab ratings are compiled from previous observations, as well as individual taxa ratings for apple scab, recorded yearly during the months of June through September, the principal period for disease expression by the apple scab fungus.

none = no scab noted.

trace = a few leaves affected; no negative effect on aesthetics.

minor = 20%-50% of leaves affected; significant defoliation and/or leaf yellowing; negative effect on aesthetics.

major = 50%-90% of leaves affected; severe defoliation and discoloration of leaves; almost complete negation of any aesthetic effect.

[5] Tree height is expressed in feet.

Table 2. Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Adams'	mid-July to late December Maroon-red fruits, deep pink flowers, rounded form.	18-20
	Positives: Abundant oval-shaped fruit; attractive striated bark on upper trunk and branches; nice yellow fall color; fast-growing tree. Negatives: Tenacious fruit mummies may remain for up to two years; mummies may detract from aesthetics during bloom and summer appearance; chlorotic foliage noted during summer. Diseases: Major leaf scab.	
'Adirondack'	late August to mid-December Orange-red fruits, white flowers, narrow upright form.	15-18
	Positives: One of the best for tight, columnar form; great autumn fruit/foliage combination; fruit ripens to a deep orange-red; fruit appears singular rather than clustered; annual consistent flowers are red-tinged. Negatives: Somewhat slow to establish and grow; leafhoppers appear to relish the foliage but no apparent harm from the feeding. Diseases: No scab.	
'American Masterpiece'	late August to mid-November Yellow-orange fruits, red-pink flowers, broadly rounded form.	18-20
	Positives: Large, spectacular flowers. Negatives: Very susceptible to scab; an intense scab season may totally defoliate the tree by late July. Diseases: Major fruit and leaf scab.	
'American Salute'	mid-August to late November Red-orange fruits, rose-purple flowers, upright spreading form.	25-28
	Positives: Great autumn fruit/foliage combination; fall foliage color ranges from reds to apricot and oranges; fruit ripens to a deep red-orange; fruit can line branches creating an incredible fruit display; very fast growing tree. Negatives: Develops into a very large tree; scabby leaves remain on the tree; very susceptible to scab. Diseases: Major leaf scab.	
'American Spirit'	late August to mid-December Maroon-red fruits, rose-pink flowers, broadly rounded form.	15-18
	Positives: Great flower display when blooming; fruit with oblong shape. Negatives: Somewhat slow to establish and grow; very susceptible to scab; an intense scab season may defoliate the tree by mid-August. Diseases: Major scab.	
'American Triumph'	mid-September to late January Maroon fruits, rose-pink flowers, broadly rounded form.	18-20
	Positives: Nice flower display when blooming. Negatives: Very susceptible to scab; an intense scab season may defoliate the tree by late July. Diseases: Major scab.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
Malus baccata 'Jackii'	mid-August to late January Maroon-red fruits, white flowers, broadly rounded form.	18-20
Positives: Reliable flower display; large, glossy green leaves, by far the best foliage of any crabapple in the plot; outstanding fall contrast of yellow- to rust-colored leaves against attractive maroon-red fruit; frosty temperatures cause bark to take on an orange cast. Negatives: Relative sparseness of fruit clusters and mediocre overall winter appearance. Diseases: No scab.		
'Beverly'	late July to mid-October Bright pinkish-red fruits, white flowers, broadly rounded form.	20-25
Positives: Consistent flowers; impressive fruit display from late summer through early fall; profuse pink buds opening to snowy white flowers in spring. Negatives: Muddied, rotted fruits turn black beginning mid-fall through winter; fruits partially eaten by birds creating an unsightly mess on the tree; sprawling, awkward growth habit. Diseases: No scab; however, moderate fireblight noted in 1994.		
'Bob White'	mid-October to late January Gold-yellow fruits, white flowers, broadly rounded form.	18-20
Positives: Persistent, small, firm fruits maturing mid-winter into striking orange-gold color; an excellent fruit color for fall and winter landscapes; exceptional floral display of delicate white blossoms mixed with pinkish-red buds; overall one of the better yellow-fruiting selections of the plot. Negatives: Fruit/floral display alternates yearly from profuse to sparse; lacks summer appeal due to inconspicuous green fruit color. Diseases: Trace of scab noted for the first time in 2005.		
'Brandywine'	mid-June to late October Yellow-green fruits, deep-pink double flowers, rounded form.	18-20
Positives: Incredible flower is without equal; double, fragrant, deep-pink flowers appear as tiny roses; great fall foliage color; large leaves with burgundy overtones; great smooth, silver-colored bark. Negatives: Very large fruit; slow to establish and grow; cedar-apple rust may disfigure leaves in some areas. Diseases: Minor fruit and leaf scab.		
'Callaway'	late August to mid-November Cherry-red fruits, white flowers, broadly rounded form.	18-20
Positives: Lovely white flowers; shiny cherry-red fruits; large green, scab-resistant foliage. Negatives: Large fruited crabapple; a heavy fruit set can disfigure tree by loading down young branches. Diseases: No scab.		
M. zumi 'Calocarpa'	late-August to mid-December Red fruits, white flowers, broadly rounded form.	15-18
Positives: Consistent annual flower display; abundant clusters of tiny, petite, shiny red fruit; neat red pedicel effect created after the fruit falls off. Negatives: Fruits shrivel rapidly after a few frosts; overall winter appeal is limited. Diseases: Minor leaf and trace of fruit scab.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Camelot'	mid-July to late October Rose-pink fruits, white flowers, dwarf rounded form.	8-10
	Positives: Oblong, unique colored fruit; petite, lovely fuschia-tinged flower; diminutive size is great for space limited areas; foliage dark green with burgundy overtones. Negatives: Very slow growing; dull summer leaf appearance. Diseases: No scab.	
'Canary'	mid-August to mid-November Yellow fruits, white flowers, upright open form.	12-15
	Positives: Bright yellow, tiny fruits hang in clusters along branches to accentuate open form; nice autumnal fruit/foliage combination creates a blaze of yellow; cider brown fruit generates aesthetic interest in a fall with mild temperatures. Negatives: Early defoliation from scab; fruit deteriorates rapidly to cider brown and falls off quickly after a few frosts. Diseases: Minor leaf and trace of fruit scab.	
'Candymint'	mid-July to late November Red-purple fruits, pink flowers, low spreading form.	8-10
	Positives: Graceful low spreading form; reliable fruit/flower displays; burgundy-tinged leaves; new stems are a deep burgundy; new foliage is striking, shiny wine-red. Negatives: Very slow growing; fruit display is never overwhelming; dull summer leaf appearance. Diseases: Trace of leaf scab.	
'Canterbury'	mid-July to late October Rose-pink fruits, white flowers, rounded form.	8-10
	Positives: Oblong, unique colored fruit; petite, lovely fuschia-tinged flower; diminutive size is great for space limited areas; foliage dark green with burgundy overtones. Negatives: Very slow growing; dull summer leaf appearance. Diseases: No scab.	
'Centurion'	mid-June to late October Cherry-red fruits, rose-red flowers, upright spreading form.	18-20
	Positives: Attractive blossom show; nice glossy new fruit; fall foliage colors to a rust-orange. Negatives: Fruits dull with age; awkward appearance of open splayed branches as tree matures. Diseases: Major leaf and trace of fruit scab.	
'Cinderella'	late August to mid-November Golden-yellow fruits, white flowers, dwarf rounded form.	4-6
	Positives: Snowy-white flower display; tiny fruits start yellow and mellow to golden hue; diminutive tree form excellent for restricted spaces. Negatives: Fruit hidden and unnoticed until leaf drop; fruit quickly turns cider brown with warmer temperatures; mediocre summer appeal. Diseases: Trace of scab; apple mosaic virus noted.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Coralburst'	early October to early November Yellow-green fruits, coral-pink double flowers, dense-rounded form.	12-15
	Positives: Tree form is consistent and easy to identify; double flowers can be showy. Negatives: Fruit hidden and unnoticed until leaf drop; fruit rarely noticed due a type of fruit russeting and same color as leaves; strap-like leaves are very susceptible to scab. Diseases: Major scab.	
'David'	mid-September to mid-November Scarlet fruits, white flowers, rounded form.	12-15
	Positives: Abundant snowy-white flower display; impressive cherry-like fruits; nice tree form. Negatives: yearly floral/fruit displays alternate from profuse to sparse; large mummies hang from late fall to mid-winter; mediocre summer appeal. Diseases: Trace of scab.	
'Dolgo'	early August to mid-September Red-purple plum-like fruits, snowy-white flowers, large rounded form.	15-18
	Positives: Consistent, very early annual bloomer; almost neon red-purple fruits are edible and great for jam and jellies; fruit impressive for a brief period during mid-summer. Negatives: Major fruit mess due to fruit drop; overripe fruit smell is intoxicating and attractive to yellowjackets; lacks ornamental effect for much of the year. Diseases: No scab.	
'Donald Wyman'	mid-September to late March Bright red fruits, white flowers, broadly rounded form.	22-25
	Positives: Excellent floral display; persistent glossy fruits remain effective, turning mud-red after a freeze; attractive exfoliating bark develops on mature trees. Negatives: Tenacious fruit mummies hang into early summer; heavy fruit scab repeatedly reduces overall appeal. Diseases: Minor leaf and major fruit scab.	
'Doubloons'	early October to mid-December Lemon-gold fruit, white double flowers, rounded form.	10-12
	Positives: Double flowers are gorgeous with carmine tinted outer petals contrasting with inner silky-white petals; lemon-yellow fruit mellows to gold with each frost; fruit color rarely noticed due to fruit scab and a type of fruit russeting. Negatives: Slow to establish and grow; mediocre appeal for most of the growing season until leaves drop. Diseases: Minor leaf and trace of fruit scab.	
'Excalibur'	mid-September to mid-December Golden-yellow fruit, white flowers, dwarf rounded form.	8-10
	Positives: Consistent rounded tree form; tiny, small, shiny fruit is outstanding in the fall; fruit-lined branches create striking specimen in the landscape; fruits mature to a shiny cider brown color but interest still retained. Negatives: Flowers can be hidden by rapidly expanding foliage; fruit is hidden to the plant interior until leaves drop. Diseases: No scab; apple mosaic virus noted.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Firebird'	mid September to late January Red-orange fruit, white flowers, dwarf upright spreading form.	8-10
	Positives: Consistent tree form is achieved by top grafting (high graft) and is perfect for restricted spaces; small fruit matures to deep red; nice flower display. Negatives: Slow to establish and grow; flower and fruit displays are scattered and steady but never dazzling. Diseases: No scab.	
M. floribunda	mid-October to early November Yellow fruit, white flowers, broadly rounded form.	12-15
	Positives: Airy floral display of pink-red buds opening to white flowers; great commingling of yellow and cider-brown fruit colors for autumnal effect; fruit may develop a red blush; feathery effect of pedicels in winter. Negatives: Yellow flecking of foliage in summer; very short time of fruit impact; relatively ordinary appearance for much of the year. Diseases: Minor scab.	
'FoxFire'	early September to mid-November Cherry-red fruit, white flowers, broadly rounded form.	12-15
	Positives: Fruit has a unique beak or point located on the calyx end; fast-growing tree; consistent form; nice clean foliage; fruit color mellows with each frost. Negatives: Mediocre appeal until fruits color; fireblight can be a problem. Diseases: No scab; very susceptible to fireblight.	
'Glenn Mills/Winter Gem'	late August to mid-April Bright red fruits, white flowers, broadly rounded form.	15-18
	Positives: Dependable annual bloom; petite, firm, shiny fruit is sensational; long-lasting fruit effect; consistent tree form; fast to establish and grow. Negatives: Mediocre summer appeal. Diseases: Major leaf and trace of fruit scab.	
'Golden Raindrops'	mid-October to early December Yellow fruits, white flowers, open spreading form.	20-22
	Positives: Petite, lemon-yellow fruits; interesting cutleaf, glossy deep-green foliage; reliable fruit/flower display; great autumnal leaf color; contrasting yellow-orange bark. Negatives: Bland green fruit throughout the summer; tree form unruly without pruning; fireblight can kill this tree. Diseases: No scab; very susceptible to fireblight.	
'Guinevere'	late August to mid-November Cherry-red fruit, white flowers, dwarf broadly spreading form.	6-8
	Positives: Horizontal orientation of branches is interesting aspect; flower and fruit displays are steady annual events but scattered along the branches. Negatives: Slow to establish and grow; flower and fruit displays are okay but never dazzling. Diseases: No scab; apple mosaic virus noted.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Hamlet'	late Aug to mid-November Maroon-red fruit, rose-pink flowers, dwarf broadly spreading form.	8-10
	Positives: Horizontal orientation of branches is interesting aspect; bronze green foliage; flower and fruit displays are steady annual events but scattered along the branches. Negatives: Slow to establish and grow; flower and fruit displays are okay but never dazzling. Diseases: No scab; apple mosaic virus noted.	
'Harvest Gold'	late October to mid-December Butter-yellow fruits, white flowers, upright open form.	18-20
	Positives: Attractive butter-yellow fruits mature to golden yellow; nice contrast of red pedicels against fruit clusters. Negatives: Long period of bland green fruit well into mid-fall; leaves hang on for a long time, hiding the fruit; awkward, gangly form; extensive fruit scab. Diseases: Major leaf and fruit scab; very susceptible to fireblight.	
'Henning/Henningii'	late July to late September Orange-red fruits, white flowers, upright open form.	22-25
	Positives: Profuse annual flower show; attractive fruit display for brief period. Negatives: Awkward, upright gangly form; extensive scab. Diseases: Major leaf and fruit scab.	
'Holiday Gold'	late September to late March Golden-yellow fruits, white flowers, open spreading form.	15-18
	Positives: One of the best new, yellow-fruited crabapples in the plot; annual flower show and fruit display is excellent; attractive cream-yellow fruits mellow to golden yellow; rose blush accents nicely yellow fruits; fruits hang in distinct clusters along branches. Negatives: Tree form may become awkward due to fruit load. Diseases: No scab; trace of fireblight.	
M. adstringens 'Hopa'	fruits never effective Red fruits, rose-red flowers, upright spreading form.	22-25
	Positives: Consistent annual, large blooms. Negatives: Scabby fruit never develops color; very early defoliation due to extreme susceptibility to scab; gangly, awkward tree form. Diseases: Major leaf and fruit scab.	
'Indian Magic'	mid-July to early February Orange-red fruits, rose-pink flowers, mounded spreading form.	12-15
	Positives: Outstanding fruit display; unbelievable autumnal orange-red fruits with golden yellow underside; emerging foliage a pleasing burgundy; fall foliage an apricot-orange color; unfailing pink floral show. Negatives: Tenacious fruit mummies; defoliation in mid- to late summer from scab, although fruit scab is minimal. Diseases: Major leaf and trace of fruit scab.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Indian Summer'	early June to mid-February Red fruits, rose-red flowers, broadly rounded form.	15-18
Positives: Consistent annual, large blooms; prolific mid-summer to fall display of large red fruits; contrasting fruits complement yellow-orange fall foliage. Negatives: Persistent fruit mummies; early defoliation from scab. Diseases: Major scab.		
'Jewelberry'	early June to mid-February Red-orange fruits, white flowers, dwarf broadly rounded form.	6-8
Positives: Open, airy, diminutive tree form is its best feature; tiny fruit size complements tree form in years with heavy fruit set. Negatives: Alternates yearly from heavy to light flower and fruit display; persistent fruit mummies; early defoliation from scab; some winter injury/dieback observed. Diseases: Major leaf and trace of fruit scab.		
'King Arthur'	mid-September to mid-January Red-orange fruits, white flowers, dwarf mounded spreading form.	10-12
Positives: Fruits artfully scattered along branches; craggy branches and open tree form enhance appearance after leaves drop. Negatives: Slow to establish and grow; some tendencies to alternate yearly from heavy to light flower and fruit display. Diseases: No scab; apple mosaic virus noted.		
'Lancelot'	early October to early December Yellow fruits, white flowers, dwarf upright spreading form.	8-10
Positives: Diminutive size is great for space-limited areas; consistent tree form; fruit is a pleasing mix of cider and yellow. Negatives: Extremely tight, dense tree form; fruit/flower mostly hidden on the interior of the tree. Diseases: Trace of scab; apple mosaic virus noted.		
'Lollipop'	mid-September to mid-December Red-orange fruits, white flowers, dwarf rounded form.	6-8
Positives: Consistent tree form is achieved by top grafting (high graft) and is perfect for restricted spaces; very tiny fruit matures to red; nice flower display. Negatives: Slow to establish and grow; flower and fruit displays are scattered and steady but never dazzling. Diseases: No scab.		
'Liset'	early July to mid-December Maroon-red fruits, rose-red flowers, open rounded form.	12-15
Positives: Consistent flower display; nice fall contrast of fruits with peach-colored foliage; new foliage is deep burgundy and matures to a bronze green. Negatives: Awkward splayed growth habit; minimal fruit-foliage contrast; fruit mummies hang on until late fall. Diseases: Trace of scab. Note: Unusual, but apparently normal, splitting of bark along branches and trunk is characteristic.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Louisa'	late July to mid-November Lemon-gold fruits, pink flowers, true weeper form.	12-15
	Positives: Reliable annual bloom is a true pink; flower display is extraordinary, like pink clouds; arching, graceful branches are upswept at ends; tree form is greatest asset; fruit mellows to a gold-orange with a rose blush accent. Negatives: Fruit set is consistently light and scattered, never dazzling. Diseases: No scab.	
'Madonna'	fruits never effective Brown-red fruits, double white flowers, upright spreading form.	18-20
	Positives: Double blooms are sparkling white and fragrant; consistent annual flower display. Negatives: Scabby fruit never develops color; very early defoliation due to extreme susceptibility to scab and frogeye leaf spot; tree form can be awkward. Diseases: Major leaf and fruit scab; major frogeye leaf spot; very susceptible to fireblight.	
'Manbeck's Weeper'	mid-September to mid-January Cherry-red fruits, white flowers, spreading-weeping form.	6-8
	Positives: Exquisite mix of pink buds opening to white blossoms; reliable annual fruit and flower displays; shiny red fruit accents the elegant spreading weeper growth habit; new twig growth is an attractive red color. Negatives: Pruning necessary to keep center from becoming too cluttered. Diseases: Minor leaf scab and trace of fruit scab.	
'Mary Potter'	mid-Aug to mid-November Red fruits, white flowers, spreading-weeping form.	8-10
	Positives: Abundant masses of reddish fruit; profuse pink buds open to create an incredible flower display; elegant spreading growth habit; salmon-colored underbark revealed as older bark peels away. Negatives: Fruit mummies a distraction during winter months. Diseases: Trace of scab.	
'Molten Lava'	early September to mid-December Red-orange fruits, white flowers, mounded spreading form.	12-15
	Positives: Consistent, profuse flower/fruit shows; fiery red fruits and yellowing fall foliage on cascading branch structure create a "molten lava" effect; excellent winter ratings due to layered horizontal branching; feathery effect created by red pedicels after fruit drops. Negatives: Branches somewhat cluttered as tree matures; lacks summer appeal. Diseases: Minor scab.	
'Narrangansett'	early September to mid-December Cherry-red fruits, white flowers, mounded spreading form.	10-12
	Positives: Nice flower display; abundant, firm fruit. Negatives: Cluttered, dense branching structure; tendency toward alternating sparse and abundant yearly flower displays; awkward tree form. Diseases: Major leaf and minor fruit scab.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Ormiston Roy'	late August to late March Orange-yellow fruits, white flowers, broadly rounded form.	18-20
Positives: Very attractive glossy orange-yellow fruits with cream underside and red blush; orangish deep-furrowed bark color intensifies as temperatures drop; consistent annual floral and fruit show. Negatives: Tenacious mummified fruit may remain up to one year. Diseases: Trace of scab.		
M. halliana 'Parkmanii'	mid-October to early November Yellow fruit, white double flowers, broadly rounded form.	12-15
Positives: Airy floral display of pink-red buds opening to white flowers; great mix of yellow and cider-brown fruit colors for autumnal effect; fruit may develop a red blush; feathery effect of pedicels in winter. Negatives: Very short time of fruit impact; relatively ordinary appearance for much of the year. Diseases: Minor scab.		
'Pink Princess'	early June to mid- October Maroon-red fruits, rose-pink flowers, dwarf mounded spreading form.	6-8
Positives: Unique downswept tree form; very pleasing pink bloom complements tree shape; tiny fruits and small leaves; tree form is its greatest strength. Negatives: Burgundy-tinted green leaves turn dull bronze in summer; fruits lost against foliage. Diseases: Trace of scab.		
'Pink Satin'	mid-August to mid-October Cherry-red fruits, pink flowers, upright open form.	10-12
Positives: Very nice, true pink bloom; fruit a pleasing red with yellow underside. Negatives: Persistent blackened mummies can be overwhelming; fruit color rarely noticed due to fruit scab and a type of fruit russeting; pruning necessary to reduce cluttered branch structure. Diseases: Major leaf and fruit scab.		
'Prairie Maid'	early July to mid-November Rosy-red fruits, deep pink flowers, broadly spreading form.	8-10
Positives: Reliable, wonderful flower display; abundant clusters of small fruit; emerging foliage is burgundy red; great autumnal yellow leaf color. Negatives: Lacking in winter appeal; waxy coating dulls fruit finish until coating weathers off. Diseases: No scab.		
'Prairifire'	late June to early December Red-purple fruits, coral-red flowers, open rounded form.	15-18
Positives: Yearly spectacular bloom and fruit displays; blooms contrast with newly emerged red-tinted green foliage; firm purplish fruits slowly age to cherry-red; fabulous fall colors range the spectrum from red to orange to apricot; unique lenticel-speckled bark. Negatives: Mediocre winter and early summer appearance. Diseases: Trace of scab.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Professor Sprenger'	late September to mid-December Orange-red fruits, white flowers, mounded spreading form.	18-20
	Positives: Dependable, large, attractive white flowers; large orange-red fruits; young tree form with fruit is stunning. Negatives: Mud-brown mummies persist until late winter; awkward growth habit and tree form with maturity; dull appearance of large yellow-green fruit during the summer. Diseases: Minor scab; defoliation from frog-eye leaf spot.	
'Profusion'	mid-July to mid-October Cherry-red fruits, rose-pink flowers, upright spreading form.	20-22
	Positives: Dependable, very attractive floral display; abundant fruit. Negatives: Lack of contrast between purple-bronze colored foliage and fruits and flowers; mediocre winter appeal; rotted fruit and mummies persist until late winter; extensive defoliation from apple scab. Diseases: Major scab.	
'Purple Prince'	late July to mid-November Blue-purple fruits, rose-red flowers, broadly rounded form.	12-15
	Positives: Large, dark unusual colored fruit; very nice yearly fruit/flower display; fast-growing tree; leaves deep green with a burgundy tint. Negatives: Lacking fruit/foliage contrast; mediocre winter appearance. Diseases: Trace of scab.	
'Radiant'	fruits never effective Cherry-red fruits, red-pink flowers, mounded spreading form.	22-25
	Positives: Beautiful red-pink blossoms; leaves emerge red-purple and fade to bronze; almost neon-red fruit may be evident in late summer. Negatives: Total lack of contrast between foliage, fruit, and flowers; consistently defoliated from scab; scab causes fruit to be unsightly and unnoticed; mummified fruit can persist for months. Diseases: Major leaf and fruit scab.	
'Ralph Shay'	early September to mid-October Red fruits, white flowers, broadly spreading form.	8-10
	Positives: Large fruit is edible and tasty; uniform tree shape; red buds open to white flowers. Negatives: Fruit drop creates an unsightly rot and mess; codling moth fruit damage deforms fruit and causes early drop; scab on fruit can dull appearance. Diseases: Major leaf and fruit scab.	
'Rawhide'	mid-September to late October Red fruits, white flowers, narrow upright form.	15-18
	Positives: Unique upright elliptical form; large white flowers emerging from red-pink buds; large shiny green leaves; handsome, fast-growing tree; large fruit is edible and tasty. Negatives: Large fruit creates unsightly mess when it drops; fruit only provides a short time of impact. Diseases: No scab.	

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Red Barron'	mid-July to late October Deep red fruits, red-pink flowers, upright spreading form.	15-18
Positives: Interesting pumpkin-shaped fruits; exfoliating bark on mature tree trunk. Negatives: Tree defoliation due to scab susceptibility; unsightly fruit mummies can persist for two years; gangly, splayed open tree form; scab on fruit blackens appearance. Diseases: Major leaf and fruit scab.		
'Red Jade'	late August to mid-November Red fruits, white flowers, spreading weeper form.	10-12
Positives: Graceful spreading growth habit adds winter interest; attractive oblong fruits; yearly prolific red flower buds open to large white blossoms. Negatives: Persistent fruit may create an unsightly rotten blob effect until dropping; scab on fruit can dull appearance. Diseases: Minor leaf and fruit scab.		
'Red Jewel'	early September to mid-April Cherry-red fruits, white flowers, open oval form.	12-15
Positives: Phenomenal firm fruits are outstanding and appealing well into spring; very attractive snow white blooms arise from red-pink buds; enticing green glossy leaves. Negatives: Mediocre late winter to early spring appearance; very slow-growing tree; tenacious mummies; tree form a bit awkward. Diseases: Trace of scab; occasional fireblight.		
'Red Splendor'	late May to early November Red fruits, rose-pink flowers, upright spreading form.	18-20
Positives: Exceptional profuse, red fruits age to orange-salmon color by mid-fall; red-tinged new, emerging foliage; reliable fruit display and lovely pink flowers. Negatives: Severe Japanese beetle feeding; early defoliation due to scab; poor winter ratings due to rotted, half-eaten mummies. Diseases: Major leaf and fruit scab.		
'Red Swan'	mid-September to mid-December Red fruits, white-pink flowers, true weeper form.	8-10
Positives: Tiny red fruits age to orange-red by mid-fall; great contrast of fruits and brilliant yellow fall foliage; fine texture to twigs and leaves; excellent weeping form with upswept branch ends. Negatives: Slow to establish. Diseases: Trace of scab.		
'Robinson'	mid-July to late-September Maroon-red fruits, rose-purple flowers, mounded spreading form.	22-25
Positives: Excellent peach to burnt orange fall foliage colors; red-tinged new, emerging foliage maturing to bronze green; reliable lovely flower and fruit displays. Negatives: Poor winter ratings due to retention of rotted fruits; tree form is coarse; extensive yearly defoliation from scab. Diseases: Major leaf and fruit scab.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Royal Fountain'	late July to mid-September Maroon-red fruits, rose-pink flowers, true weeper form.	8-10
Positives: Exceptional long, fine weeping branches; petite maroon-red fruits artfully scattered along branches; tree form is greatest asset; fine foliage a bronze-green with burgundy overtones. Negatives: Unreliable fruit/flower displays; some defoliation due to scab. Diseases: Minor scab.		
'Royal Scepter'	early August to late October Cherry-red fruits, rose-pink double flowers, upright spreading form.	15-18
Positives: Red fruits age to red-orange; leaves a bronze-green with burgundy overtones. Negatives: Fruits blacken with scab and also as they become overripe; early defoliation due to scab; poor winter ratings due to charcoal-like mummies. Diseases: Major leaf and fruit scab.		
'Royalty'	fruits never effective Dark red fruits, red-purple flowers, mounded spreading form.	12-15
Positives: Unique red-purple foliage. Negatives: Extensive yearly defoliation due to scab; poor winter ratings due to horrific, blackened persistent mummies. Diseases: Major leaf and fruit scab.		
'Ruby Luster'	mid-August to mid- October Rose-red fruits, rose-pink flowers, broadly rounded form.	25-28
Positives: Silvery bark color; unique bronze red-purple foliage. Negatives: Extensive yearly defoliation due to scab; very large fruit has russetted, coarse, dull finish and color; large, fast-growing tree. Diseases: Major leaf and fruit scab.		
M. sargentii	mid-August to late October Dark red fruits, white flowers, low spreading form.	6-8
Positives: Greatest asset is attractive low-spreading growth habit; petite snowy white blossoms; effective firm fruits in late summer to early fall. Negatives: Fruits deteriorate rapidly; shriveled raisin mummies persist into winter; some winter damage noted. Diseases: No scab.		
'Selkirk'	late July to mid-September Cherry-red fruits, rose-red flowers, broadly rounded form.	18-20
Positives: Excellent floral show as rosy buds open to large rose-red flowers; glossy red fruits; unique red-tinged, emerging foliage contrasts nicely with the flowers; foliage changes from burgundy green maturing to a green-bronze; striking profuse red fruits in mid-summer. Negatives: Extensive early defoliation due to scab; codling moth damage deforms the large fruit; large fruit creates rotten mess when dropping. Diseases: Major leaf and fruit scab.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Sentinel'	early September to early February Red fruits, white flowers, upright spreading form.	15-18
Positives: Vase-shaped growth habit; sensational floral display of profuse rose-colored buds open to pink-tinged white flowers; pleasing yellow fall foliage contrasts fruits; attractive firm fruits persist into early spring. Negatives: Tenacious fruit mummies may hang into summer; mediocre overall summer appearance. Diseases: Minor leaf and fruit scab.		
'Silver Drift'	mid-September to early April Cherry-red fruits, white flowers, broadly rounded form.	18-20
Positives: Outstanding, persistent, showy glossy-red fruit; yearly performance of red buds opening to white flowers is wonderful; interesting contrast of last year's fruit with emergence of new leaves in spring; fast-growing tree; unvarying tree form; retains leaves even though affected by scab. Negatives: Tenacious mummies; fruit obscured by foliage. Diseases: Minor scab.		
'Silver Moon'	early September to mid-December Red-purple fruits, white flowers, mounded spreading form.	18-20
Positives: Glossy unique-colored fruits; peculiar dense upright candelabra growth habit; good late, snowy-white floral show from light pink buds; very intense maroon-reds and peach fall leaf colors. Negatives: Yearly bloom alternates from profuse to sparse; poor winter ratings due to somewhat cluttered growth. Diseases: No scab; fireblight can be severe.		
'Sinai Fire'	mid-September to late November Red-orange fruits, white flowers, open spreading form.	12-15
Positives: Uncommon open growth habit with horizontal branches; good specimen plant; yearly floral show with large blooms. Negatives: Fruit scattered and sparse; slow growing; unique form is not for every landscape. Diseases: No scab; fireblight can be a problem.		
'Snowdrift'	mid-August to late November Salmon-red fruits, white flowers, broadly rounded form.	18-20
Positives: Reliable, excellent yearly flower show; distinctly colored attractive fruits; feathery and colorful effect of pedicels in winter. Negatives: Fruits shrivel by late fall; chlorotic summer foliage. Diseases: Major scab.		
'Spring Snow'	no fruits produced No fruit produced, white flowers, oval form.	22-25
Positives: Red-pink buds open to large white flowers; fast-growing tree. Negatives: Sterile flowers do not produce fruit; extensive early defoliation due to scab; very large tree. Diseases: Major scab.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Strawberry Parfait'	mid-August to mid-April Red-cream fruits, pink flowers, open erratic spreading form.	15-18
Positives: Fruits age to deep red; yearly pink flowers borne on spur-lined branches; newly emerged foliage is a burgundy color; leaves mature to green with burgundy tint; unusual, somewhat erratic, upright-spreading growth habit; good fall color; fruits remain firm through late winter. Negatives: Tenacious fruit mummies; unusual shape is not for every landscape. Diseases: Trace of scab.		
'Sugar Tyme'	late September to early April Cherry-red fruits, white flowers, mounded spreading form.	15-18
Positives: Stunning sugar-white floral display from pale pink buds; showy, persistent firm fruits through late winter; good overall form; dense foliage. Negatives: Mediocre appearance during summer before fruit colors; foliage appears off-color or chlorotic during mid to late summer; fruit drops all at once before bloom; fruit color often muted due to a type of fruit russeting. Diseases: Minor scab.		
'Thunderchild'	fruits ineffective Blue-purple fruits, rose-red flowers, oval upright form.	12-15
Positives: Leaves and new twig growth an intriguing dark purple-red. Negatives: Awkward growth; fruiting spur pronounced, long, and pointed; extreme lack of flower/fruit/foliage contrasts; extensive early defoliation due to scab. Diseases: Major leaf and fruit scab.		
M. sargentii 'Tina'	early August to late November Red-purple fruits, white flowers, low spreading form.	4-6
Positives: Petite, densely packed, creamy-white flowers arise from diminutive red buds; neat miniature tree or bonsai-like appearance; very dainty aspect to twigs and foliage. Negatives: Very slow grower; annual pruning is critical aspect of maintenance. Diseases: No scab.		
M. tschonoskii	fruits never effective Yellow-green fruits, white flowers, pyramidal form.	30-35
Positives: Large silver-gray, pubescent leaves; incredible fall foliage colors of purple, orange-scarlet, yellow, and crimson; unique, rare tree form. Negatives: Ugly fruit rarely seen or noticed; flowers scattered and sparse; extremely sensitive and susceptible to fireblight. Diseases: No scab; extreme fireblight problems.		
'Velvet Pillar'	late October to mid-November Maroon-red fruits, pink flowers, elliptical upright form.	18-20
Positives: Interesting bronze-purple foliage; fruits effective only when the foliage falls off. Negatives: Dingy overall appearance to foliage; extensive early defoliation due to scab; scattered and sparse fruit/flower displays; persistent fruit mummies. Diseases: Major scab.		

Table 2 (continued). Aesthetic Profiles of Crabapples in Secrest Arboretum.

Crabapple	Time of Effective Fruit Display[1]	Mature Tree Size[2]
'Weeping Candied Apple'	fruits rarely effective Candied-apple red fruits, rose-pink flowers, open spreading form.	12-15
Positives: Reliable, attractive flowers; interesting horizontal to pendulous branch habit. Negatives: Irregular form not for all landscapes; fruit display devastated by scab; extensive early defoliation due to scab; tree form can become awkward. Diseases: Major leaf and fruit scab.		
'White Angel'	mid-October to early February Red fruits, white flowers, broadly rounded form.	18-20
Positives: Reliable, attractive flowers; showy medium-sized abundant fruits; red coloration of most recent twig growth; one of the nicer crabapples as a mature tree. Negatives: Awkward splayed shape when young until limbs can withstand fruit load; tenacious mummies distract during mid- to early spring. Diseases: No scab.		
'White Cascade'	mid-September to mid-November Yellow-green fruits, white flowers, true weeper form.	12-15
Positives: Exquisite flower display of cascading flower-covered branches; appealing overall tree form. Negatives: Perpetually dingy foliage throughout summer because of scab; fruit scab completely destroys any potential fruit effect; early and extreme defoliation. Diseases: Major scab on leaves and fruit.		
'Winter Gold'	early November to mid-January Lemon-gold fruits, white flowers, upright open form.	22-25
Positives: Lemon-green fruits mature to an impressive lemon-gold; nice contrast of bright red pedicels against fruit clusters. Negatives: Leaves hang on for a long time, hiding the fruit; long period of bland green fruit (well into mid-fall); tree form can be awkward, gangly; extensive fruit scab can diminish impact. Diseases: Major leaf and fruit scab; susceptible to fireblight.		

[1] Time of Effective Fruit Display is derived from observations conducted monthly throughout the year. Effective fruit impact is defined as the period from when the tree's fruit first contributes to tree aesthetics until the fruit is no longer ornamental.

[2] Tree height is expressed in feet (12 inches = 1 foot).

Selected References

1. den Boer, John H. 1995. Blossom Times. Malus — The International Ornamental Crabapple Society Bulletin. 9(1). pp. 10-16.

2. Draper, E. A., Chatfield, J. A., Herms, D. A., and Cochran, Kenneth D. 2005. Apple Scab on Crabapple at Secrest Arboretum: 2004. Ornamental Plants: Annual Reports and Research Reviews. Special Circular 195. pp. 189-192. The Ohio State University, Ohio Agricultural Research and Development Center.

3. Draper, E. A., Chatfield, J. A., and Cochran, Kenneth D. 2004. 10 Crabapples to Know, Show, and Grow. Ornamental Plants: Annual Reports and Research Reviews. Special Circular 193. pp. 167-169. The Ohio State University, Ohio Agricultural Research and Development Center.

4. Draper, E. A. , Chatfield, J. A., and Cochran, Kenneth D. 2003. A Collection of Crabapple Knowledge from Secrest Arboretum: 1993-2002. Ornamental Plants: Annual Reports and Research Summaries. Special Circular 189. pp. 119-138. The Ohio State University, Ohio Agricultural Research and Development Center.

5. Fiala, Father John L. 1994. Flowering Crabapples — The Genus Malus. Timber Press, Portland Oregon.

”

~ 14 ~
Apple Scab on Crabapple at Secrest Arboretum: 2005

James A. Chatfield, Erik A. Draper, Daniel A. Herms, and Kenneth D. Cochran

Introduction

Apple scab incidence was moderate at the Secrest Arboretum of The Ohio State University's Ohio Agricultural Research and Development Center (OARDC) in 2005. Early spring was wet, but from early May through June, conditions were quite dry, probably resulting in lower than average primary and secondary infections by the Venturia inaequalis pathogen during that period.

Of the 72 crabapple taxa in the Crablandia II planting at Secrest, 24 showed no evidence of apple scab in 2005, and a total of 33 never received a rating that exceeded 1 (no aesthetic impact) on any evaluation date. Eighteen taxa received a rating of 3 or higher on at least one date in 2005, indicating substantial defoliation and aesthetic impact (Table 1).

Materials and Methods

Sixty three crabapple taxa were planted in 1997-98 at the Secrest Arboretum of OARDC (Wooster, Ohio) in a completely randomized design, with an additional nine taxa planted in 2003. There are five replicate plants for most, but not all, taxa, though less replicates exist currently due to a variety of factors, including inadequate original numbers (e.g., 'Hamlet'), death due to fireblight (e.g., 'Golden Raindrops'), and other attrition such as deer damage.

Plants are mulched with composted yard waste and were irrigated as needed during the year of transplanting. Weeds are controlled with spot applications of glyphosate. On June 21, July 13, and August 18, 2005, all trees were rated on a scale of 0-5, with 0 = no scab observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5 to 20% of leaves affected, with some yellowing but little or no defoliation, moderate aesthetic impact; 3 = 20 to 50% of leaves affected, significant defoliation and/or leaf yellowing, substantial aesthetic impact; 4 = 50 to 80% of leaves affected, severe foliar discoloration and defoliation, severe aesthetic impact; and 5 = 80 to 100% of foliage affected, with 90 to 100% defoliation.

Results and Discussion

Results of the 2005 trials are presented in Table 1.

James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science; Erik A. Draper, Ohio State University Extension, Geauga County; Daniel A. Herms, Ohio Agricultural Research and Development Center, The Ohio State University, Entomology; and Kenneth D. Cochran, Secrest Arboretum, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, Ohio.

Despite significant levels of scab (18 taxa with apple scab ratings indicating significant symptoms and aesthetic effects), one third of the crabapple taxa at Secrest Arboretum for the 2005 season exhibited no scab. This provides horticulturists with many crabapple selections with excellent scab resistance, from pink-flowered weepers ('Louisa') to white-flowered dwarfs (Malus sargentii), from golden-fruited crabapples ('Holiday Gold') to red-fruited trees ('Red Jewel').

Results over the past several years show that, for some taxa, scab incidence is changing, presumably due to the development of new races of the Venturia inaequalis pathogen. Apple scab was not observed on 'Prairifire' crabapple until 2000 and 2001 when it first was noted, though at very low levels. Scab was found on 'Bob White' in 2004-2005 for the first times. This year, scab was noted on 'Canterbury,' 'Callaway', 'Camelot,' and 'Cinderella' for the first time in our plots.

Bacterial fireblight (Erwinia amylovora) incidence at Secrest was low in Crablandia again in 2005, presumably due to lower temperatures during bloom than in the peak fireblight years of 2001-2002. Cedar rusts (Gymnosporangium spp.) have not been significant on crabapples at Secrest in the past, and this year was no exception, except for a trace of rust on 'Brandywine.' Frogeye leaf spot (Botryosphaeria obtusa) incidence was high on certain cultivars, including 'Coralburst,' 'Professor Sprenger,' 'David,' 'Purple Prince,' and 'Strawberry Parfait.'

Table 1. Apple Scab on Crabapples at Secrest Arboretum in Wooster, Ohio, in 2005.

Crabapple Taxon	Aug 18	Jul 13	Jun 21	Number of Reps
'Adirondack'	0.00*	0.00	0.00	5
'Cardinal'	0.00	0.00	0.00	3
'Dolgo'	0.00	0.00	0.00	5
'Excalibur'	0.00	0.00	0.00	4
'Firebird'	0.00	0.00	0.00	5
'Foxfire'	0.00	0.00	0.00	5
'Golden Raindrops'	0.00	0.00	0.00	2
'Hamlet'	0.00	0.00	0.00	2
'Holiday Gold'	0.00	0.00	0.00	5
'Jackii'	0.00	0.00	0.00	5
'King Arthur'	0.00	0.00	0.00	2
'Lollipop'	0.00	0.00	0.00	5
'Louisa'	0.00	0.00	0.00	5
'May's Delight'	0.00	0.00	0.00	5
'Orange Crush'	0.00	0.00	0.00	5
'Prairie Maid'	0.00	0.00	0.00	5

Table 1 (continued). Apple Scab on Crabapples at Secrest Arboretum in Wooster, Ohio, in 2005.				
Crabapple Taxon	**Aug 18**	**Jul 13**	**Jun 21**	**Number of Reps**
'Prairie Rose'	0.00	0.00	0.00	4
'Pumpkin Pie'	0.00	0.00	0.00	5
'Rawhide'	0.00	0.00	0.00	4
Malus sargentii	0.00	0.00	0.00	5
'Silver Moon'	0.00	0.00	0.00	4
'Sinai Fire'	0.00	0.00	0.00	5
'Strawberry Parfait'	0.00	0.00	0.00	4
'Tina'	0.00	0.00	0.00	5
'Canterbury'	0.20	0.20	0.20	4
'Red Jewel'	0.20	0.20	0.00	5
'Pink Princess'	0.20	0.00	0.00	5
'Callaway'	0.25	0.00	0.00	4
'Beverly NSF'	0.33	0.00	0.33	5
'Purple Prince'	0.40	0.00	0.00	5
'Guinevere'	0.60	0.00	0.00	5
'Bob White'	0.80	0.80	0.60	5
'Camelot'	0.80	1.00	1.00	5
'Prairifire'	1.00	0.40	0.20	5
'Royal Raindrops'	1.00	1.00	1.00	4
'Scarlet Brandywine'	1.00	1.00	0.33	3
'Coralburst'	1.00	1.00	1.00	5
'Brandywine'	1.25	1.00	1.00	4
'David'	1.40	1.00	0.80	4
'Candymint'	1.60	0.80	0.80	5
'Professor Sprenger'	1.75	1.75	1.50	4
'Lancelot'	1.80	1.00	1.00	5
M. zumi 'Calocarpa'	1.80	0.00	0.00	5
'Cinderella'	2.00	1.00	1.00	4
'Mary Potter'	2.00	1.75	1.25	4
'Silver Drift'	2.20	1.80	1.40	5
'Sugar Tyme'	2.20	1.00	1.00	5
'Manbeck Weeper'	2.40	2.00	1.20	5
'Donald Wyman'	2.40	2.20	1.60	5

Table 1 (continued). Apple Scab on Crabapples at Secrest Arboretum in Wooster, Ohio, in 2005.

Crabapple Taxon	Aug 18	Jul 13	Jun 21	Number of Reps
'Royal Fountain'	2.50	2.00	1.80	4
'Molten Lava'	2.60	2.00	1.00	5
'Canary'	2.60	2.80	1.80	5
'Red Jade'	2.75	2.00	1.50	4
'American Salute'	2.80	3.00	2.00	5
'Doubloons'	3.00	1.80	1.60	5
'Harvest Gold'	3.00	3.20	2.20	5
'Adams'	3.00	2.80	2.40	5
'Red Splendor'	3.00	2.00	1.20	5
'Sentinel'	3.00	2.80	2.00	5
'Royal Scepter'	3.00	2.40	1.00	5
'Spring Snow'	3.20	3.20	0.60	5
'Snowdrift'	3.60	2.80	2.00	5
'White Cascade'	3.60	2.80	1.20	5
M. floribunda	3.60	2.80	2.00	5
'American Spirit'	3.75	2.75	2.00	4
'Jewelberry'	4.00	3.00	2.00	4
'Weeping Candied Apple'	4.00	3.00	3.00	5
'American Triumph'	4.00	2.80	1.80	5
'Pink Satin'	4.20	3.80	2.40	5
'Thunderchild'	4.60	3.60	2.20	5
'American Masterpiece'	4.80	3.60	2.20	5
'Indian Magic'	5.00	3.25	2.50	4

* 0 = no scab observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5 to 20% of leaves affected, with some yellowing but little or no defoliation, moderate aesthetic impact; 3 = 20 to 50% of leaves affected, significant defoliation and/or leaf yellowing, substantial aesthetic impact; 4 = 50 to 80% of leaves affected, severe foliar discoloration and defoliation, severe aesthetic impact; and 5 = 80 to 100% of foliage affected, with 90 to 100% defoliation.

References

Draper, E. A., Chatfield, J. A., Herms, D. A., and Cochran, K. D., 2004. Apple Scab on Crabapple at Secrest Arboretum: 2004. In Ornamental Plants: Annual Reports and Research Reviews. Special Circular 195: 189-192. The Ohio State University, Ohio Agricultural Research and Development Center.

Draper, E. A., Chatfield, J. A., and Cochran, K. D. 2004. Apple Scab on Crabapple at Secrest Arboretum: 2003. In Ornamental Plants: Annual Reports and Research Reviews. Special Circular 193:135-139. The Ohio State University, Ohio Agricultural Research and Development Center.

Draper, E. A., Chatfield, J. A., and Cochran, K. D. 2004. 10 Crabapples to Know, Show, and Grow. In Ornamental Plants: Annual Reports and Research Reviews. Special Circular 193: 170-180. The Ohio State University, Ohio Agricultural Research and Development Center.

Draper, E. A., Chatfield, J. A., and Cochran, K. D. 2003. A collection of crabapple knowledge from Secrest Arboretum: 1993-2002. In Ornamental Plants: Annual Reports and Research Reviews. Special Circular 189: 119-138. The Ohio State University, Ohio Agricultural Research and Development Center.

Chatfield, J. A., Draper, E. A., Herms, D. A., and Cochran, K. D. 2002. Apple scab on crabapples at Secrest Arboretum: 2001. In Ornamental Plants: Annual Reports and Research Reviews. Special Circular 186: 93-96. The Ohio State University, Ohio Agricultural Research and Development Center.

Ferree, D. C., Schmid, J. C., and Cochran, K. D. 2004. Performance of Five Ornamental Crabapples (Malus sp.) on Seven Size-Controlling Rootstocks. In Ornamental Plants: Annual Reports and Research Reviews. Special Circular 195: 71-76. The Ohio State University, Ohio Agricultural Research and Development Center.

Fiala, Fr. John L. 1994. Flowering Crabapples — The Genus Malus. Timber Press, Portland, Oregon.

Acknowledgments

The authors would like to thank Ohio nurseries, including Lake County Nursery, Klyn Nurseries, Sunleaf Nursery, Willoway Nursery, and others for support and plant material for this project as well as Bailey Nurseries of Minnesota and J. Frank Schmidt Nursery of Oregon for plant material and participation in the International Ornamental Crabapple Society National Crabapple Evaluation Project. We would also like to thank the Secrest Arboretum of the Ohio Agricultural Research and Development Center of Ohio State University, especially the always professional and helpful grounds department headed by James Karcher.

”””

~ 15 ~

Ornamental Crabapple (Malus sp.) Phenology in Southern Ohio

Shawn R. Wright, Brad Bergefurd, Joseph F. Boggs,
James A. Chatfield, Lynn R. Miller

Introduction

Ornamental crabapples are excellent four-season landscape trees. From early spring bloom, leading to attractive green to bronze leaf color in the summer, and continuing on with colorful fruit in autumn and winter, crabapples have much to offer the homeowner. They have several tree forms (weeping, upright spreading, columnar, rounded) and range in size from small trees (8 to 10 feet in height) to medium size (25 feet). These characteristics make Malus a good choice for both the homeowner and the nursery trade.

The International Crabapple Society evaluated 48 of the best taxa across a wide geographic range from 1988 through 1993 and published this data in the journal Malus (1). Others have also evaluated the aesthetic qualities of ornamental crabapples (2, 3), disease resistance (4, 5, 6), and flowering (7, 8). This on-going study will provide information on the year-round aesthetic qualities of 22 taxa of ornamental crabapples in southern Ohio so that the nursery trade will have useful information on locally appropriate selections and so that the consumer will have the opportunity to observe the various selections side-by side.

Materials and Methods

Fourteen taxa ('Adirondack,' 'Firebird,' 'Holiday Gold,' 'Indian Magic,' 'Lollipop,' 'Louisa,' 'May's Delight,' 'Orange Crush,' 'Prairie Rose,' 'Prairiefire,' 'Pumpkin Pie,' 'Scarlet Brandywine,' 'Spring Sensation,' and Malus x zumi 'Calocarpa') were planted in early May of 2004 at The Ohio State University South Centers, Piketon, Ohio. Bareroot trees were planted 25 feet on center on tiled Doles silt loam (fine-silty, mixed, mesic, Aeric Fragiaqualfs). Planting design was a completely randomized block with at least three replications of each taxa with an overall goal for the plot of 22 taxa and five replicates.

Eight additional varieties ('Sentinel,' 'Indian Summer,' 'Adams,' 'White Cascade,' 'Candymint,' 'Lancelot,' 'Sugar Tyme,' and 'Sargentina') were planted in mid-June of 2005. The 2005 planting was with containerized (2 gallon) whips. Trees were watered as needed during the planting year. Growing degree days were monitored using a base-50 (F) modified

Shawn R. Wright, OSU Extension Center at Piketon; Brad Bergefurd, OSU Extension Center at Piketon; Joseph F. Boggs, Ohio State University Extension, Hamilton County, and the OSU Extension Center at Piketon; James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science; Lynn R. Miller, OSU Extension Center at Piketon;

Table 1. Mean Phenologic Stage and Standard Error of the Mean (2<n<6).

Growth stage 1 = dormant, 2 = silver tip, 3 = green tip, 4 = 1/2" green, 5 = tight cluster, 6 = pink, 7 = first bloom, 8 = full bloom, 9 = petal fall.

		GDD																				
Variety		81	92	107	116	128	152	186	202	210	219	226	252	281	306	319	329	330	340	352	383	398	484
Adirondack	mean	2.6	3.8	4.0	4.0	4.0	4.4	5.4	5.8	6.0	6.0	6.0	6.4	7.0	8.0	8.0	8.4	8.6	9.0	9.0	9.0	9.0	9.0
	sem	0.2	0.2	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0
Firebird	mean	1.0	1.0	1.6	2.0	3.0	4.0	5.0	5.0	5.0	5.2	5.6	6.0	6.0	6.2	6.8	7.6	7.8	8.0	9.0	9.0	9.0	9.0
	sem	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.4	0.2	0.2	0.0	0.0	0.0	0.0	0.0
Holiday gold	mean	1.7	2.3	2.7	3.3	3.7	4.7	5.3	5.3	5.7	6.0	6.0	6.0	7.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.3	0.3	0.3	0.3	0.3	0.3	0.7	0.7	0.3	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indian Magic	mean	2.0	2.5	4.0	4.0	4.3	5.0	6.0	6.0	6.3	6.3	6.3	7.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lollipop	mean	1.0	1.0	2.0	2.2	3.0	3.8	4.2	4.8	5.0	5.4	5.8	6.0	6.0	6.6	6.8	7.8	8.0	8.4	9.0	9.0	9.0	9.0
	sem	0.0	0.0	0.0	0.2	0.0	0.2	0.2	0.2	0.0	0.2	0.2	0.0	0.0	0.2	0.2	0.2	0.0	0.2	0.0	0.0	0.0	0.0
Louisa*	mean	2.7	4.0	4.0	4.0	5.0	6.0	6.0	6.0	6.0	6.0	6.3	7.0	8.0	8.7	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redbud	mean	3.0	3.6	4.0	4.0	5.0	5.2	6.0	6.0	6.0	6.0	6.0	6.6	8.0	8.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May's Delight	mean	1.7	2.0	4.0	4.0	4.0	4.3	5.0	6.0	6.0	6.0	6.0	6.0	7.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Orange Crush	mean	2.0	2.8	4.0	4.0	4.2	4.8	5.8	6.0	6.0	6.0	6.0	6.0	7.8	8.2	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.0	0.4	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prairie Rose*	mean	2.0	3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.3	4.7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	7.3	8.0	9.0
	sem	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
Prairiefire	mean	2.3	2.8	4.0	4.0	4.3	5.0	6.0	6.0	6.0	6.0	6.0	6.3	7.0	8.3	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.3	0.5	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pumpkin Pie	mean	2.0	2.8	3.8	4.0	4.0	4.3	5.5	6.0	6.0	6.0	6.0	6.0	6.5	7.8	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0
	sem	0.0	0.3	0.3	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scarlet Brandywine	mean	2.0	3.3	3.3	4.0	4.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	7.0	8.0	8.0	8.0	8.0	8.3	9.0	9.0	9.0	9.0
	sem	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Spring Sensation	mean	1.0	1.0	1.7	2.7	3.0	4.0	5.0	6.0	6.0	6.0	6.0	6.0	6.3	7.3	8.0	8.0	8.7	9.0	9.0	9.0	9.0	9.0
	sem	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0

* 2 'Prairie Rose' and 2 'Louisa' never flowered and were not included in the calculations for these varieties

sine wave GDD model (Jan. 1 start date), and plant development was evaluated based on standard growth stages (9).

Results

Monitoring began March 29, 2005, and was completed on May 16, 2005. Evaluations were performed at noon, and the cumulative GDD for the previous day was used as that day's GDD value.

By March 29, 11 of the varieties had already broken dormancy. 'Indian Magic' was the first to flower at 210 GDD; however, that was only one tree, and the remainder of the trees did not flower until 252 GDD. Average first bloom for 'Indian Magic' and 'Louisa' was 252 GDD, which corresponded to April 17 this year. 'Prairie Rose' was the latest blooming taxon, first flowering at 383 GDD. This was almost one month later than 'Indian Magic' first flowering.

Discussion

The year 2005 was unusual in that temperatures rose above freezing on March 22 and never dropped below freezing again until May 4. Flowering duration was shortened this year by heavy rains on April 21-23. While 2004 was an excellent growing year, 2005 was one of the driest on record in Piketon, and there was severe defoliation on the newly planted trees. While no insects were observed, the signs were similar to what would be expected from the yellow-necked caterpillar.

We are beginning to establish our database for this trial. It will be valuable and interesting to follow this for many years. While evaluations have been done in other regions, there is nothing specific for southern Ohio.

Literature Cited

1. Fall 95 Vol. 9, No. 2. Malus: International Ornamental Crabapple Bulletin 9(2). pp. 8-56.
2. den Boer, John H. and Thomas L. Green. 1995. Disease and Aesthetic Ratings. Malus: International Ornamental Crabapple Bulletin. 9(2). pp. 8-56.
3. Draper, Erik A. and James A. Chatfield. Aesthetic Evaluation of Crabapples at the Secrest Arboretum in Wooster, Ohio: 1993-1994. Ornamental Plants: A Summary of Research. Special Circular 142. pp. 1-9. The Ohio State University, Ohio Agricultural Research and Development Center.
4. Chatfield, James A. and Erik A. Draper. 1995. Evaluation of Crabapples for Apple Scab at the Secrest Arboretum in Wooster, Ohio: 1993-1994. Ornamental Plants: A Summary of Research. Special Circular 142. pp. 10-12. The Ohio State University, Ohio Agricultural Research and Development Center.
5. den Boer, John H. and Thomas L. Green. 1995. Disease and Aesthetic Ratings. Malus: International Ornamental Crabapple Bulletin. 9(2). pp. 8-56.
6. Draper, Erik A. and James A. Chatfield. 1996. Evaluation of Crabapples for Apple Scab at the Secrest Arboretum in Wooster, Ohio: 1994-1995. Ornamental Plants: Annual Reports and Research Summaries. Special Circular 152. pp. 22-26. The Ohio State University, Ohio Agricultural Research and Development Center.
7. den Boer, John H. 1995. Blossom Times. Malus: International Ornamental Crabapple Society Bulletin. 9(1). pp. 10-16.
8. Draper, Erik A. and James A. Chatfield. 1996. Emergence, Longevity, and Aesthetic Evaluations of Flowers in Ornamental Crabapples at Secrest Arboretum in Wooster, Ohio: 1995. Ornamental Plants: Annual Reports and Research Summaries. Special Circular 152. pp. 27-31. The Ohio State University, Ohio Agricultural Research and Development Center.
9. Chapman, P. J., and Gertrude A. Catlin. 1976. Growth Stages in Fruit Trees — From Dormant to Fruit Set. New York's Food and Life Sciences Bulletin. New York State Agricultural Experiment Station, Geneva. No. 58.

~ 16 ~

Field Evaluation of Various Herbicide and Mulch Combinations for Ornamental Weed Control

Hannah M. Mathers and Luke T. Case

Significance to the Industry

Weed control is the largest expense facing the nursery and landscape industries. These industries are big business in the United States, with more than $10 billion in sales for the nursery industry and $625 billion for the overall landscape industries worldwide (Hall et al., 2005). In an industry where aesthetics determine profitability, zero-tolerance of weeds is often adopted.

Data indicate that the integration of two tactics of weed control — mulch + preemergent herbicides — produces a positive interaction, offering a promising alternative pest management system and simplifying and enhancing the safety and effectiveness of applications by using an integrated pest management approach.

Nature of Work

Oliveira et al. (2000) found that the controlled release of herbicides using lignin as the matrix offered a promising alternative technology for weed control.

Knight et al. (2001) found that the application of preemergent herbicides onto organic mulches reduced herbicide leaching by 35 to 74% compared with bare-soil preemergent herbicide applications. This research project involved two experiments and three objectives:

- Determine the efficacy and duration of weed control of 10 herbicide-mulch combinations.
- Assess the phytotoxicity of the 10 herbicide-mulch combinations on two ornamental plants.
- Determine efficacy and phytotoxicity of three application methods for each herbicide-mulch combination.

The two experiments conducted were efficacy (Experiment 1) and phytotoxicity (Experiment 2). Both experiments were started on May 1, 2004, and ended April 15, 2005. They were repeated in 2005 at The Ohio State University's Waterman Farm in Columbus, Ohio.

The plots in Experiment 1 contain no crop plants. Evaluations of efficacy were conducted at 30, 60, 90, 120, and 350 days after treatment (DAT) using dry weights and visual ratings from 1 x 1 ft sections in the 3 x 3 ft (0.9 m) plots. Efficacy ratings

Hannah M. Mathers, Department of Horticulture and Crop Science, The Ohio State University; Luke T. Case, Department of Horticulture and Crop Science, The Ohio State University.

were on a scale of 0 (no control) to 10 (complete control) and > 7 (commercially acceptable).

In Experiment 2, dogwood shrubs and crabapple tree liners were evaluated. A visual rating score of 1 (no injury) to 10 (complete kill) and < 3 (commercially acceptable) was used for the shoots.

The herbicide-treated mulches and herbicide-mulch application methods were compared to sprays of the five chemicals applied directly to the surfaces of the plots, the two untreated mulches applied to the plots, and a weedy check (no herbicide, no mulch). Mulches were applied untreated, over the top of soil surfaces sprayed with the different herbicides. Mulches were also applied untreated to untreated soil surfaces and then sprayed with the different herbicides in the field.

The five chemicals applied were:

- Oryzalin, Surflan (AS) (aqueous solution) 2 lb (ai)/acre.
- Flumioxazin, (SureGuard WDG) 0.34 lb (ai)/acre.
- Acetochlor (Harness) 2.5 lb (ai)/acre.
- Dichlobenil (Casoron CS) 4 lb (ai)/acre.
- A combination of oryzalin and flumioxazin.

Two bark types were evaluated, pine nuggets and shredded hardwood.

Pretreated bark mulch treatments were prepared by placing a single layer of the mulches on a sheet of plastic, sprayed over the top with the different herbicide treatments, and allowed to dry for 48 hours. Treated barks when dry and untreated mulches were applied directly to evaluation plots in varying amounts according to the mulch thickness. The mulches were applied as close as possible to a single layer.

Results and Discussion

Efficacy ratings and dry weights showed significant differences with treatment and date. Only dry weights had significant treatment x date interactions. Twenty of 38 treatments had efficacy ratings of > 7, pooled over all evaluation dates (Figure 1). Only one was a direct spray, Surflan + SureGuard (7.6).

Three were pretreated mulches, Surflan + SureGuard (8.2), Harness (7.8), and Surflan (7.4) treated pine (Figure 1). None of the pretreated hardwood barks provided ratings of > 7.

Eight of the 20 were treatments with the herbicides applied under the bark. Seven of the eight provided ratings of > 8: Surflan + SureGuard under pine (9.1), Casoron under pine (8.9), Surflan under pine (8.7), Harness under pine (8.0), Surflan + SureGuard under hardwood (8.0), SureGuard under hardwood (8.0), and SureGuard under pine (8.0) (Figure 1).

Eight of 20 were treatments with the herbicides applied over the bark with five providing ratings of > 8: SureGuard over pine (9.1), Casoron over pine (9.0), Harness over pine (8.3), Surflan over pine (8.3), and Casoron over hardwood bark (8.0).

The untreated pine (3.5) and untreated hardwood (1.5) provided significantly better efficacy than the control (0.15); however, these three treatments were three of the five least efficacious treatments in the trial (Figure 1).

At 350 DAT, four treatments were still providing above commercially acceptable weed control; none were direct sprays; none involved hardwood bark; and

one was a pretreated mulch, Surflan + SureGuard pretreated pine (7.3) (Figure 2). The other three treatments were Casoron over pine (8.2), Surflan + SureGuard over pine (7.6), Casoron under pine (7.4) (Figure 2).

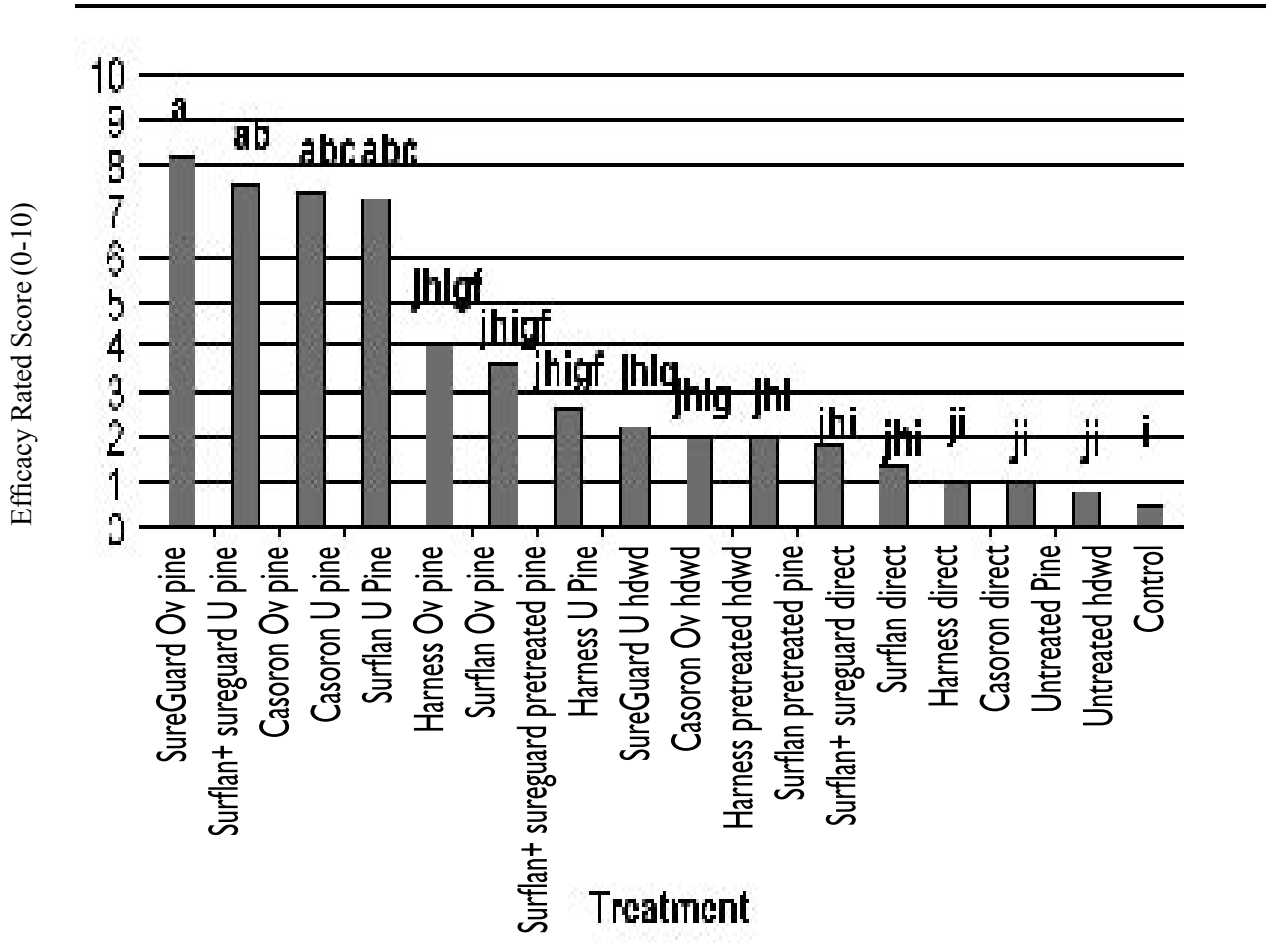


Figure 1. Efficacy-rated score data for herbicide-treated mulch experiment pooled over 30, 60, 90, and 120 days after treatment (DAT). The abbreviations OV, U, P, and Hdwd mean over, under, pine, and hardwood bark, respectively. Different letters signify least significant difference (LSD) P = 0.05.

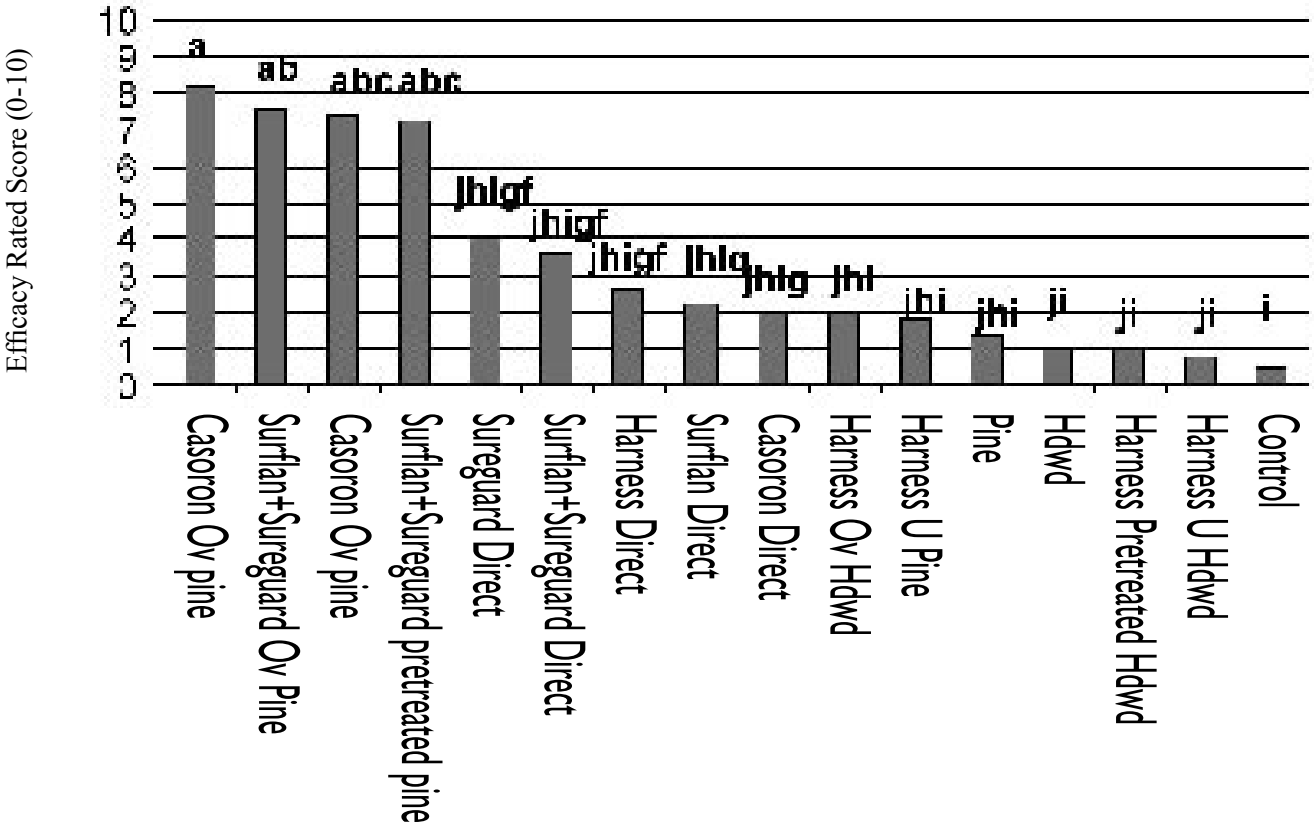


Figure 2. Efficacy-rated score data for herbicide-treated mulch experiment 350 days after treatment (DAT). The abbreviations OV, U, P, and Hdwd mean over, under, pine, and hardwood bark, respectively. Different letters signify least significant difference (LSD) P = 0.05.

Literature Cited

Hall, C., Hodges, A., Haydu, J. 2005. Economic Impacts of the Green Industry in the United States. Draft (in review).

Knight, P. R, C. H. Gilliam, S. L. File, and D. Reynolds. 2001. Mulches reduce herbicide loss in the landscape. Proc. South. Nurs. Assn. Res. Conf. 46:461-463.

Oliveira, S. C., Pereira, F. M., Ferraz, A., Silva, F. T. and Goncalves, A. R. 2000. Mathematical modeling of controlled-release systems of herbicides using lignins as matrices. Applied Biochem. and Biotech. Vol. 84-86: 595-615.

”

~ 17 ~

Field Caliper Tree Production Using Retractable Roof Greenhouse-Grown Liners

Hannah M. Mathers, Luke T. Case, Elizabeth S. Grosskurth, and Michele M. Bigger

Significance to Industry

Retractable roof greenhouses (RRGs) (as flat-roof or peaked-roof curtain houses) offer a number of production and marketing advantages compared to conventional container production. RRGs have been found to increase plant water-use efficiency (WUE) and nitrogen-use efficiency (Stoven et al., 2005), increase growth (Lowe et al., 200x; Stoven et al., 2005), cut production times of certain crops in half (Mathers, 2001), reduce wind-throw problems and extend growing seasons (Stoven et al., 2005).

They have also proved their utility in producing superior containerized tree liners (Mathers et al., 2002; Stoven et al., 2005). The RRG-grown containerized liners offer a feasible alternative to field bareroot liner production based on price, availability, and niche markets such as coarse-rooted, difficult-to-transplant, and native taxa. Additionally, data indicates RRG-grown tree liners accelerate field caliper tree production in Midwestern states when planted in October out of three-gallon containers compared to bareroot liners.

Hannah M. Mathers, Department of Horticulture and Crop Science, The Ohio State University; Luke T. Case, Department of Horticulture and Crop Science, The Ohio State University; Elizabeth S. Grosskurth, Department of Horticulture and Crop Science, The Ohio State University; and Michele M. Bigger, Department of Horticulture and Crop Science, The Ohio State University.

Nature of Work

At The Ohio State University (OSU) Waterman Farm, Columbus, Ohio, four species of tree liners were out-planted from three environments. A soil test was conducted in September 2003. All nutrients were in the surplus (P and K), high (Mg) to medium range (Ca) with the exception of nitrogen. Soil pH was 7.5, CEC was 13.1, and organic matter was 4.7%.

In May 2004, 48g/tree or 100 lb N/ac of 34-0-0 was applied. Then, 34-0-0 was also applied on April 11, 2005, at 42g/ tree and on June 6, 2005, for a total of 171 lb N/ac. A Netafim USA (Fresno, Calif.) In-Line Dripperline Assembly was set up to apply water on an as-needed basis.

The three environments where liners had been produced were (1) a peaked RRG (Cravo Equipment, Ltd., Brantford, Ontario, Canada) in 11.4 L classic Spinout® treated containers (Nursery Supplies, Inc., Fairless Hills, Pa.), filled with a 60% pine bark, 25% peat moss, 7% composted sludge (composted municipal sewage sludge from the city of Akron, Ohio), 7% haydite and 1% sand substrate (Willoway Nurseries, Inc., Avon, Ohio), (2) a combination heated greenhouse-outdoor (CHGO) production environment also in 11.4 L containers at Ohio State, Columbus, Ohio, and (3) bareroot liners from nursery fields, Canby, Ore.

The OSU liners had been produced according to the methods described by Stoven et al. (2005). The OSU liners were planted in the field on October 5, 2003, and bareroot liners were planted (when traditionally available for planting in Ohio) April 26, 2004. All plants were trained to 2 m tall bamboo stakes (A.M. Leonard, Inc., Piqua, Ohio) installed at planting. In cases where height exceeded 2 m, 2 stakes were attached together.

The four plant taxa evaluated were Acer x freemanii 'Jeffersred' (Autumn Blaze™ red maple), Malus 'Prairifire' (Prairifire crabapple), Cercis canadensis (Eastern redbud), and Quercus rubra (red oak). Growth measures of height and caliper (taken at 15.24 cm) were recorded at planting and in June and September 2004. Measures will continue to be collected each June and September for 2005-2007.

Average initial heights and calipers for redbud, maple, crabs, and oaks out-planted from the RRG were (264.6 cm, 14.8 mm), (265 cm, 15.6 mm), (184.2 cm, 11.6 mm), (69.6 cm, 9.4 mm), respectively. Average initial heights and calipers for redbud, maple, crabapples, and oaks out-planted from the CHGO production environment were (221.7 cm, 14.8 mm), (249.6 cm, 17.7 mm), (189.2 cm, 11.8 mm), (50 cm, 8.2 mm), respectively. Average initial heights and calipers for redbud, crabapple, and oak out-planted as bareroot liners in April were (187.1 cm, 18.2 mm), (132.5 cm, 10.7 mm), (225.4 cm, 15.8 mm), respectively. There were no initial measures taken for the maples.

The redbud, maple, and oak bareroot liners had (less height, greater caliper), (less height, less caliper), and (greater height, greater caliper) at planting compared to the RRG or CHGO production environment, respectively. In early November, all the RRG and combination environment trees were pruned according to normal nursery practices. Heading-back cuts on the central leader were performed on OSU liners with excessive height and growth straight cards used to reestablish the central leader in the spring. No pruning was done to bareroot liners at time of planting.

Perennial ryegrass was seeded in the fall of 2003 between the rows and mowed as required. Row spacing between rows was 12 ft and in-row 6 ft. Height, caliper, and change (Δ) in height and caliper from June to October 2004 data were subjected to ANOVA using the GLM procedure within SAS® (SAS Institute, Inc., Cary, N.C., 2000). Fisher's least significance difference test were used to compare means; a $P < 0.05$ was used (SAS© Institute, Inc.). The Type II Sum of Squares analysis was performed, and graphs were produced in Microsoft Excel from the analyses. All factors were considered fixed effects; therefore, all terms were tested for significance against the error mean square.

Results and Discussion

The only tree mortality occurred in the oaks, with five of 12 bareroot liners having died by September 2004 (42%). One of 12 oaks died out of the CHGO production environment (8%), and there were no deaths with RRG liners (0%). Delta caliper was significant for the main effects of environment and species at $P > 0.0001$; environment X species was significant at $P = 0.06$, so will not be presented.

The RRG (Cravo)-grown liners produced significantly greater caliper increases in the field from June to September 2004 compared to the bareroot liners, producing an average increase, across species, of 6 mm; however, this difference was not significantly different than the liners obtained from the CHGO environment

(Figure 1). The main effects of species and environment were significant for September height ($P > 0.001$) (data not shown) and caliper ($P = 0.1, 0.0001$); however, environment X species interaction for both measures was also significant, so only the interactions will be presented.

With the exception of oak, the RRG (Cravo)-grown liners had the largest calipers and height in September 2004 compared to the bareroot liners; however, this difference was not significantly different than the liners obtained from the CHGO environment, again with the exception of oak (Figures 2 and 3, respectively). The oak grown bareroot in Oregon had larger caliper and height growth (Figures 2 and 3); however, keep in mind only 58% survived so this slight growth increase would not offset lost revenue at a production nursery.

Literature Cited

Lowe, S. B., H. M. Mathers, and D. K. Struve. 200x. High Temperature Stress in Containers and the Influence of Environment, Pot Type, Media, and Species. HortTechnology. (In review).

Mathers, H. M. 2001. The future is in retractables: Nursery stock production in Retractable Roof Greenhouses. The Buckeye. August. Pp. 16-17, 19, and 31.

Mathers, H., D. Struve, and A. Stoven. 2002. Tree liner production in Ohio. The Buckeye. November. Pp. 14-17.

Stoven, A. A., H. M. Mathers, and D. K. Struve. 2005. Fertilizer method affects growth, nutrient, and water use efficiency of container-grown tree liners in two production environments. HortScience. (In review).

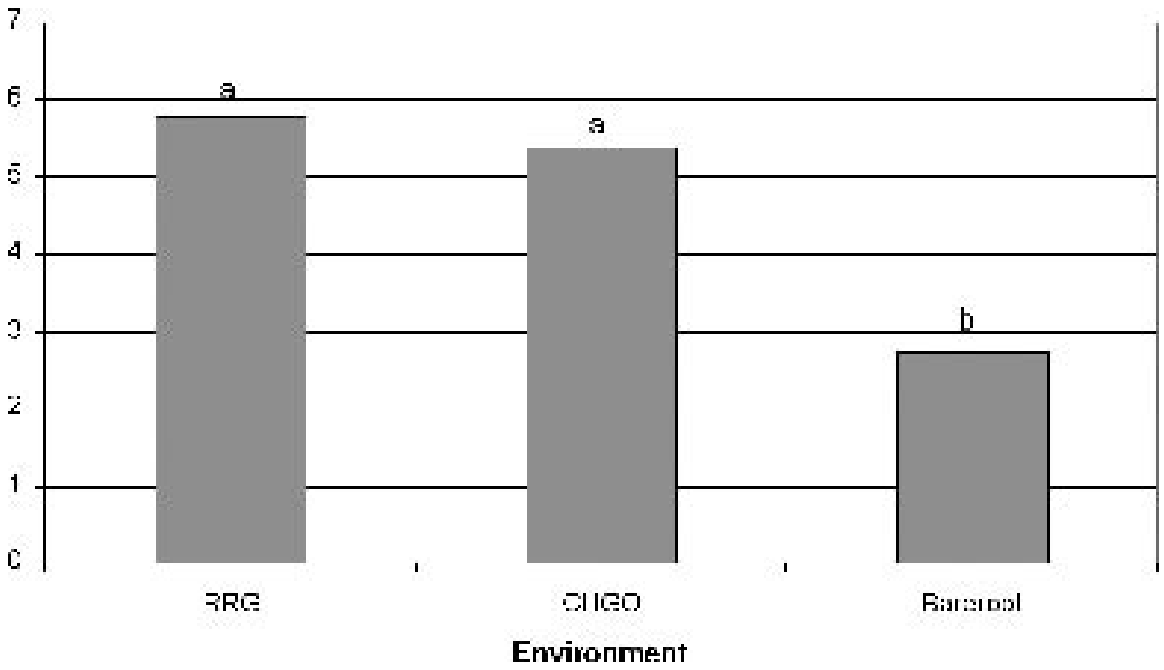


Figure 1. Field caliper increase during the period from planting October 2003 and April 2004 to September 2004 pooled over species for liners produced from three production environments. The abbreviations RRG and CHGO signify retractable roof greenhouse and combination heated greenhouse-outdoor, respectively. Different letters signify least significant difference (LSD) $P = 0.05$.

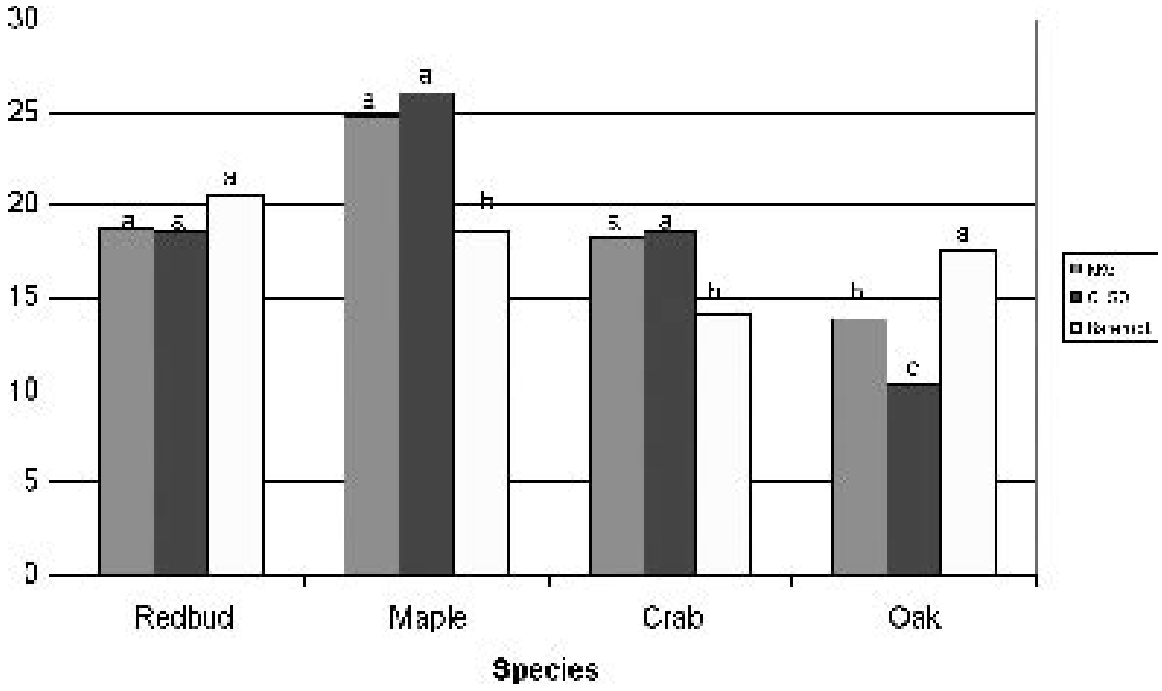


Figure 2. Field caliper measures in September 2004 for four species of liners produced from three production environments. The abbreviations RRG and CHGO signify retractable roof greenhouse and combination heated greenhouse-outdoor, respectively. Different letters signify least significant difference (LSD) P = 0.05.

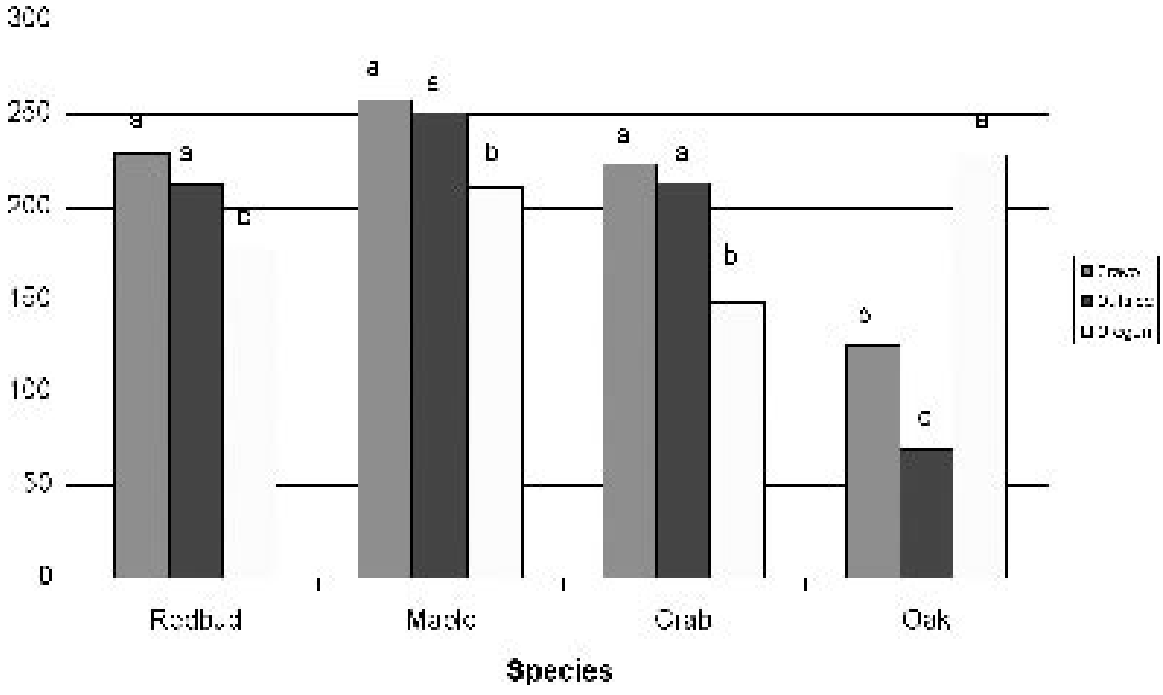


Figure 3. Field height measures in September 2004 for four species of liners produced from three production environments. The abbreviations RRG and CHGO signify retractable roof greenhouse and combination heated greenhouse-outdoor, respectively. Different letters signify least significant difference (LSD) P = 0.05.

~ 18 ~

Effects of Fertilization and Mulching on the Ectomycorrhizal Community of Paper Birch in Topsoil and Inverted Subsoil Profiles

Joseph H. LaForest, Daniel A. Herms, and Pierluigi Bonello

Introduction

Mycorrhizae are symbiotic relationships between plant roots and a specialized group of fungi (Smith and Read, 1997). The fungi receive carbohydrates from the host plant as a portion of the plant's carbon budget. The fungi allocate nutrients, such as nitrogen and phosphorus, in excess of their requirements to the host plant. By this exchange, the fungi gain access to a carbon supply that is not accessible to saprotrophic soil microbes. This increases the ability of the fungi to exploit soil substrates, and the plant gains increased access to nutrients, especially phosphorus and water (Gadgil and Gadgil, 1975). This relationship has allowed plants to survive and be more competitive in nutrient limited environments (Brundrett, 2002; Read, 1991).

In extremely nutrient-limited environments, such as subsoil in urban settings, photosynthetic rates are reduced (Herms and Mattson, 1992), and mycorrhizal symbiosis is predicted to be limited by lower levels of carbon availability, resulting from lower photosynthetic rates. Mycorrhizal fungi may also be directly limited by the amount of nitrogen or other nutrients available in the soil.

The effect of nutrient availability on the mycorrhizal community has been studied in a variety of natural systems, including spruce forests (Brandrud, 1995; Fransson, Taylor, and Finlay, 2000; Lilleskov et al., 2002; Peter, Ayer, and Egli, 2001), pine forests (Marx, 1990), coastal sage scrub (Egerton-Warburton and Allen, 2000), and Scots pine nurseries (Sen, 2001), among others.

Few studies, however, have examined mycorrhizal communities in urban environments. These differ from natural environments in that they are heavily disturbed. Plants in urban settings are often treated with fertilizers, mulches, pesticides, and biostimulants to alleviate urban stress, but objective information regarding the potential effects of all of

Joseph H. LaForest, Dow Gardens, Midland, Michigan; Daniel A. Herms, The Ohio State University, Ohio Agricultural Research and Development Center (OARDC); and Pierluigi Bonello, Department of Plant Pathology, The Ohio State University, Columbus, Ohio.

these disturbances on the mycorrhizal community is basically non-existent. Indeed, little is known even about the kind of mycorrhizal communities that are naturally present in urban environments.

Birch trees are important landscape plants, and their roots are known to form ectomycorrhizal associations with a wide variety of fungal genera in natural ecosystems, including Pisolithus, Hebeloma, Scleroderma, Amanita, Paxillus, Thelephora, and Piloderma (Cairney and Chambers, 2003). Fungal interactions with the host roots change the morphology of the root tips, allowing for preliminary differentiation of fungal types through macroscopic and microscopic examination.

To evaluate the effects of several soil treatments commonly found in the urban environment on tree mycorrhizae, we subjected test trees to two different soil types (topsoil and subsoil), mineral fertilization, and mulching. We measured fine root density, percentage mycorrhizal colonization, and diversity of the mycorrhizal fungal community as indicated by morphotyping.

This highly controlled and replicated field study, representing a simulated urban environment, was conducted at The Ohio State University, Ohio Agricultural Research and Development Center (OARDC) in Wooster, Ohio, using paper birch (Betula papyrifera Marsh).

Materials and Methods

Plot Establishment and Subsoil/Topsoil Treatment

Trenching was used to create six rows of 1.0 m^2 plots. Each row contained eight plots that were lined to a depth of one meter with 30 mil polyvinylchloride (PVC) landfill liner material. These rows were grouped into two blocks, each containing three rows of eight plots (24 total).

The soil from within each plot was removed to a depth of 50 cm and replaced with either subsoil or topsoil, resulting in the creation of topsoil and inverted subsoil profiles. The inverted subsoil profile is similar to conditions found in urban sites in which excavation results in an inversion of the normal soil profile (i.e., subsoil above topsoil).

Each soil type was replicated 12 times in each block. The topsoil originated from an agricultural field in Wooster, Ohio. The subsoil was excavated from a depth of 2 m during a pipeline construction project on OARDC's Wooster, Ohio, campus. These soils had markedly different physical and chemical properties (Table 1). One two-year-old bare-root paper birch tree, obtained from Evergreen Nursery in Sturgeon Bay, Wisc., was planted in the center of each plot on June 10, 2001, (block 2) and June 11, 2001 (block 1).

Soil Management Treatments

Soil treatments consisting of one of two mulches, fertilization, and a bare soil control were replicated six times in each block, three in each soil type. The first mulch was composted hardwood bark (C:N ratio of 70:1) (Kurtz Brothers, Groveport, Ohio) blended with composted dairy manure (C:N ratio of 13:1) (OSU Composting Facility, Wooster, Ohio) in a 4:1 ratio by volume. The blended mulch had a C:N ratio of 38:1 and was applied on June 13, 2001. Residual mulch was removed on May 1, 2002.

A second application (C:N ratio of 34:1) was made on May 7, 2002. Residual mulch was again removed on April 15, 2003, and a final application (C:N ratio of 25:1) was made on May 13, 2003. All applications added approximately 50 L of mulch to the

Table 1. Selected Physical and Chemical Characteristics of the Two Soil Types Used, Measured at the Beginning of the Experiment (2001).

	Subsoil	Topsoil
pH	6.7	6.0
Organic Matter (%)	1.5	3.5
Nitrogen (ppm)	7.5	142.3
Phosphorous (ppm)	10.0	77.5
Potassium (ppm)	79.5	157.5
Calcium (ppm)	1,335	1,580
Magnesium (ppm)	378	213
Cation Exchange Capacity (meq/100g)	10.0	11.3
Bulk Density (g/ml)	1.49	1.24
% Sand	32.8	24.1
% Silt	42.9	58.5
% Clay	24.3	17.4

plot distributed to a depth of 5 cm.

The second mulch was composted yard waste (C:N ratio of 19:1) obtained from Kurtz Brothers (Groveport, Ohio). It was applied on June 13, 2001, and removed on May 1, 2002. A second application (C:N ratio of 27:1) was made on May 7, 2002, and removed on April 15, 2003. A final application (C:N ratio of 21:1) was made on May 13, 2003. All applications added approximately 50 L of mulch to the plot distributed to a depth of 5 cm.

The fertilizer treatment followed ANSI standards and consisted of 200 kg N/ha/year (ANSI 1998). A composite 10:3:2 (N:P:K) formulation was used by combining 29.2 g of 30:10:7 (Arbor Green) (Davey Tree, Kent, Ohio) with 3.7 g of 34:0:0 ($NN_4 - NO_3$). As a result of the formulation, 59% nitrogen was in slow release form and 41% in fast release form. The fertilizer was applied in solution with 5 gallons of water to the surface of the soil on July 5, 2001; October 1, 2001; May 10, 2002; October 28, 2002; and May 6, 2003.

Fine Root Density

On November 23, 2002, and September 17, 2003, soil cores were taken 15 cm from the base of the tree to extract a 4.75 cm diameter core from the top 10 cm of the soil, excluding mulch. The cores were soaked in tap water to soften the core and transferred to a 2 mm sieve. Running water was passed over the sample to remove soil.

Roots were removed by hand and placed in 50 ml centrifuge tubes with 75% ethanol to preserve morphological characteristics. Roots were then spread in clear Petri dishes and photographed against a blue background using the negative filter of a Sony DSC-S75 digital camera in 2002 and against a white background using the black-and-white filter of the same camera in 2003. Images were analyzed using the root length algorithm of Assess (Lamari, 2002). Fine root density was calculated as the length of roots (cm) per volume of soil (cm^3).

Morphological Characterization of Ectomycorrhizae (Morphotyping)

The roots extracted from each soil core were sorted by hand, based on morphological characteristics of the mycorrhizae. These characteristics included color, texture of the fungal mantle, and emanating hyphae (Goodman et al., 1996).

Roots of different morphotypes were placed in separate test tubes. The root tips were embedded in resin (Bonello et al., 1991) and cross-sectioned using a microtome to confirm their ectomycorrhizal status by the presence of a fungal mantle and Hartig net. Each morphotype was then spread in clear Petri dishes and photographed.

The percentage of roots colonized by mycorrhizal fungi was calculated for each plot by dividing the length of mycorrhizal roots by the total root length in each core.

Statistical Analyses

SAS® was used for all statistical calculations (SAS Institute, 2001). All variables were analyzed with proc UNIVARIATE to identify any outliers and verify homogeneity of variance and normal distribution of the residuals. All means were separated by the least significant difference (LSD) test after a significant ANOVA.

Results

Fine Root Density

In 2002 and 2003, trees in topsoil plots had greater fine root density than did trees in subsoil plots (Tables 2 and 3). No differences were seen by treatment in 2002. Fertilizer increased fine root density relative to all other treatments in 2003 (Tables 2 and 3). No differences were seen in the mulch treatments (Table 3).

Morphotyping

The percentage of root length colonized by mycorrhizal fungi was significantly reduced only in the fertilized subsoil plots in 2002 relative to all other treatments, in which nearly 100% of the root length was colonized (Tables 2 and 3). In 2003, only five plots had more than one morphotype with a maximum of three in one plot (Figure 1). Consequently, there were no differences in diversity between soil types or treatments (Table 3). All trees had 100% or near 100% of the root length colonized by mycorrhizal fungi with no difference in percent colonization between soil type or treatment (Table 3).

Discussion

It is remarkable that despite the low levels of nitrogen and organic matter found in the inverted subsoil plots, mycorrhizal fungi were largely unresponsive to changes in the soil environment with near 100% of root length being mycorrhizal in both years. Mycorrhizae are known to require soil organic matter to be fully functional (Andersen and Rygiewicz,

Table 2. *F*-values from ANOVA for Soil and Treatment Effects and Their Interactions on Root Length Density and Mycorrhizal Colonization of Paper Birch in Topsoil and Inverted Subsoil Profiles.

	Error df	Soil (df = 1)	Treatment (df = 3)	Soil x Treatment (df = 3)
2002				
Fine Root Density	38	30.33 ****	0.34	0.65
Percent mycorrhizal roots	33	4.77 *	5.00 **	4.62 **
2003				
Fine Root Density	38	15.07 ***	5.18 **	0.45
Percent mycorrhizal roots	38	0.32	0.47	0.42

Significance: **** indicates $P < 0.0001$; *** indicates $P < 0.001$; ** indicates P , 0.01; * indicates $P < 0.05$.

Table 3. The Effects of Soil Type and Experimental Treatments on Fine Root Density and Percent Mycorrhizal Roots of Paper Birch.
Two soil profiles were used: Topsoil and inverted subsoil. In addition to the bare soil control, treatments included fertilization and mulching with either composted yard waste or composted hardwood bark blended with composted dairy manure (composted hwb/cdm). Means were separated by the least significant difference. For a particular variable, means in each row followed by the same letter are not statistically different ($P < 0.05$).

	Topsoil	Subsoil	Bare Soil	Fertilized	Composted HWB/CDM	Composted Yard Waste
2002						
Fine Root Density (cm/cm3)	1.48 a	0.36 b	0.83 a	1.07 a	0.94 a	0.87 a
Percent mycorrhizal roots	99.95 a	98.06 a	100.00 a	96.40 b	100.00 a	100.00 a
2003						
Fine Root Density (cm/cm3)	3.28 a	1.60 b	2.37 b	3.86 a	1.58 a	2.02 b
Percent mycorrhizal roots	99.96 a	100.00 a	99.91 a	100.00 a	100.00 a	100.00 a

1991; Smith and Read, 1997; Wallenda and Kottke, 1998; Allen et al., 2003), yet the low organic matter subsoil was able to support high levels of colonization.

The plots in which mycorrhizal colonization was reduced still maintained a very high level of mycorrhizal colonization. The high percentage of roots colonized by mycorrhizal fungi was unexpected. A similar study by Walker (2001) observed percentages from 6% to 32% of the root length colonized by ectomycorrhizal fungi.

In 2003, only five plots had more than one morphotype with a maximum of three morphotypes present in one plot. However, it is possible that the most abundant morphotype, present in the majority of plots in 2003, corresponds to several different genera of mycorrhizal fungi. Only molecular tools (e.g., Gardes et al., 1991) would allow for such a determination.

Neither soil type nor soil treatment were predictors of mycorrhizal community, i.e., the mycorrhizal types in both soils were not significantly different. Two non-mutually exclusive alternatives may explain this result:

- The mycorrhizal fungi we detected were present on the root systems of the trees at planting; i.e., they came from the nursery and persisted in our plots for the duration of the study, or:
- The same mycoflora was present in both topsoil and subsoil plots.

Since no mycorrhizal samples were taken at the beginning of the study, and since we did not conduct bioassays of the two soils, it is not possible to clarify this issue at this point. However, since the trees all came from the same nursery, they should have all started with similar mycorrhizal communities.

As no fungal species was indicative of a soil type or treatment, it is possible that the mycorrhizal community present at planting survived on the roots throughout the experiment. If fungi colonizing the roots at planting can outcompete any indigenous fungi in the soil with potential to be mycorrhizal, a significant

disturbance may be required for other mycorrhizal species to colonize the plant. Hence, the addition of commercially available mycorrhizal inoculum to the soil — a practice that is becoming more and more common these days — may not result in increased mycorrhizal colonization, since introduced fungi would be excluded by previously established species.

Further ongoing research is attempting to ascertain the origin and identity of the mycorrhizae in a similar system, the role of mycorrhizal inoculum in potential displacement of resident mycorrhizal fungi, and the role of mycorrhizal inoculum and fertilization on the stress physiology of paper birch.

References

ANSI. 1998. American National Standard for tree care operations — tree, shrub, and other woody plant maintenance — standard practices (fertilization). In A300 (Part 2): American National Standards Institute, Inc.

Allen, M. F., W. Swenson, J. I. Querejeta, L. M. Egerton-Warburton, K. K. Treseder. 2003. Ecology of mycorrhizae: A conceptual framework for complex interactions among plants and fungi. Annual Review of Phytopathology 41: 271-303.

Andersen, C. P., and P. T. Rygiewicz. 1991. Stress interactions and mycorrhizal plant response: understanding carbon allocation priorities. Environmental Pollution 73: 217-244.

Bonello, P., R. B. Pearce, F. Watt, and G. W. Grime, 1991. An induced papilla response in primary roots of Scots pine challenged in vitro with Cylindrocarpon destructans. Physiological and Molecular Plant Pathology 39, 213-228.

Brandrud, T. E. 1995. The Effects of Experimental Nitrogen Addition on the Ectomycorrhizal Fungus Flora in an Oligotrophic Spruce Forest at Gardsjon, Sweden. Forest Ecology and Management 71 (1-2):111-122.

Brundrett, M. C. 2002. Coevolution of roots and mycorrhizas of land plants. New Phytologist 154 (2):275-304.

Cairney, J. W. G., and S. M. Chambers. 2003. Ectomycorrhizal fungi: Key genera in profile. New York: Springer.

Egerton-Warburton, L. M., and E. B. Allen. 2000. Shifts in arbuscular mycorrhizal communities along an anthropogenic nitrogen deposition gradient. Ecological Applications 10 (2):484-496.

Fransson, P. M. A., A. F. S. Taylor, and R. D. Finlay. 2000. Effects of continuous optimal fertilization on belowground ectomycorrhizal community structure in a Norway spruce forest. Tree Physiology 20 (9):599-606.

Gadgil, R. L., and P. D. Gadgil. 1975. Suppression of litter decomposition by mycorrhizal roots of Pinus radiata. New Zealand Journal of Forest Science 5:33-41.

Gardes, M., T. J. White, J. A. Fortin, T. D. Bruns, and J. W. Taylor. 1991. Identification of indigenous and introduced symbiotic fungi in ectomycorrhizae by amplification of nuclear and mitochondrial ribosomal DNA. Canadian Journal of Botany 69:180-190.

Goodman, D. M., D. M. Durall, J. A. Trofymow, and S. M. Berch. 1996. A manual of concise descriptions of North American mycorrhizae including microscopic and molecular characterization. Victoria, B.C.: Mycologue Publications.

Herms, D. A., and W. J. Mattson. 1992. The dilemma of plants: to grow or defend. The Quarterly Review of Biology 67, 283-335.

Lamari, L., 2002. Assess: Image analysis software for plant disease quantification. American Phytopathological Society, Winnipeg, Manitoba, Canada.

Lilleskov, E. A., T. J. Fahey, T. R. Horton, and G. M. Lovett. 2002. Belowground ectomycorrhizal fungal community change over a nitrogen deposition gradient in Alaska. Ecology 83 (1):104-115.

Marx, D. H. 1990. Soil pH and nitrogen influence Pisolithus ectomycorrhizal development and growth in loblolly pine seedlings. Forest Science 36:224-245.

Peter, M., F. Ayer, and S. Egli. 2001. Nitrogen addition in a Norway spruce stand altered macromycete sporocarp production and below-ground ectomycorrhizal species composition. New Phytologist 149 (2):311-325.

Read, D. J. 1991. Mycorrhiza in ecosystems. Experientia 47:376-391.

Sen, R. 2001. Multitrophic interactions between a Rhizoctonia sp and mycorrhizal fungi affect Scots pine seedling performance in nursery soil. New Phytologist 152 (3):543-553.

Smith, S. E., and D. J. Read. 1997. Mycorrhizal symbiosis. 2nd Ed. New York, N.Y.: Academic Press.

Treseder, K. K., and M. F. Allen. 2002. Direct nitrogen and phosphorous limitation of arbuscular mycorrhizal fungi: a model and a field test. New Phytologist 155:507-516.

Walker, R. F. 2001. Growth and nutritional responses of containerized sugar and Jeffrey pine seedlings to controlled release fertilization and induced mycorrhization. Forest Ecology and Management 149 (1-3):163-179.

Wallenda, T., and I. Kottke. 1998. Nitrogen deposition and ectomycorrhizas. New Phytologist 139: 169-187.

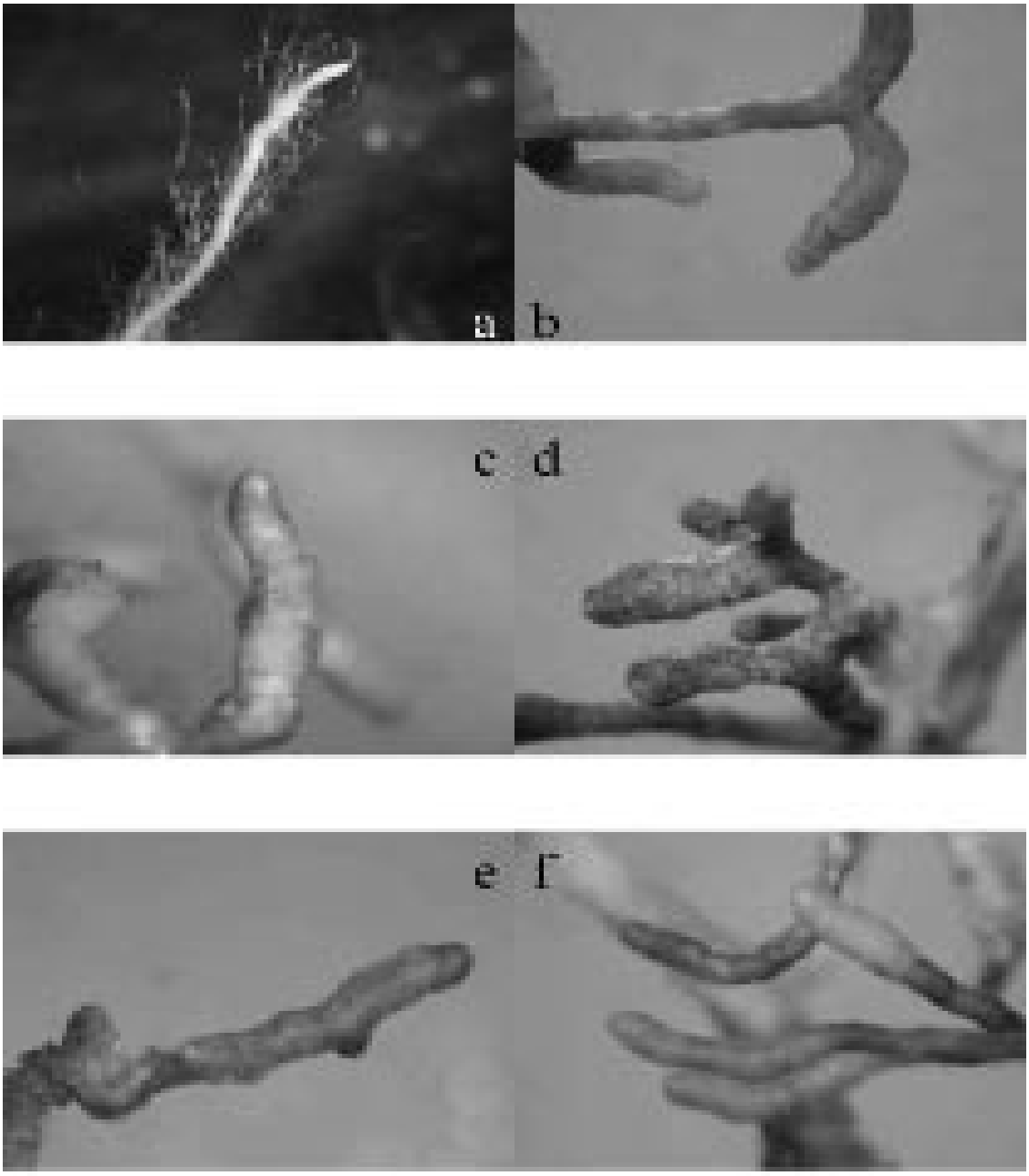


Figure 1. Photographs of the different mycorrhizal morphotypes characterized in 2002: (a) a non-mycorrhizal root tip. The white strand-like structures surrounding the root are suspected to be either root hairs or hyphae of a mycorrhizal fungus that is attempting to colonize the root tip; (b) reddish brown color and few emanating hyphae; (c) pale-brown-red with few emanating hyphae; (d) dark-reddish-brown with hyphae on the root tip producing a felt-like appearance; (e) reddish-brown with hyphae on the root tip producing a felt-like appearance; (f) light brown with a distinctive club-like appearance with few emanating hyphae. Some of these different morphotypes may represent different developmental stages of the same fungal species.

~ 19 ~
Evaluations of Billbug Control Products in Ohio

David J. Shetlar, Daniel Digman, Jennifer Andon, Wade Pinkston

Introduction

The principal billbug found in Ohio is the bluegrass billbug, Sphenophorus parvulus Gyllenhal, though we often see moderate populations of the lesser billbug, S. minimus Hart, in Ohio turfgrasses.

Nationally, billbug species are recognized as important pests of cool-season, transition, and warm-season turfgrasses (Vittum et al., 1999; Niemczyk and Shetlar, 2000), though damage from billbugs is commonly misdiagnosed. Billbug damage often resembles damage from disease or other insects and symptoms of drought stress or drought dormancy.

Damaged or killed turf usually goes undetected until summer drought and heat conditions give way to milder conditions in September, at which time the turf does not recover. By this time, most turf managers are confused as to what damaged the turf because the billbug symptoms (turf stems that break off easily and are packed with sawdust-like frass) are more difficult to see. Lawns, sport fields, and grounds usually have to be reseeded following damage from billbugs.

Billbugs are unlike white grubs and chinch bugs in that billbug damage rarely appears in years when turf is given normal to above normal rainfall. White grubs and chinch bugs can produce visible damage and cause turf death even when the turf is adequately watered. In short, billbugs and drought conditions result in extensive turf death! This death starts in June, just when most turf managers are expecting their turf to go into summer dormancy because of drought and heat conditions.

The bluegrass billbug will commonly attack Kentucky bluegrass as well as perennial ryegrass, fine fescue, and tall fescues as long as these later species do not contain endophytes (fungal symbionts that produce toxins that kill billbug adults and larvae). Billbug adults overwinter in the turf and when these turfgrasses begin to form seed stems (in May), the adult females will select the thickest stems for egg laying.

Each female will use her beak to chew a hole at the base of stems. Once the hole is formed, the female turns around and pushes a bean-shaped egg into the cavity. A week later the grub-like, but legless, larvae hatch and begin to burrow within the stem. As the larvae burrow, they leave a trail of fine, dust-like fecal pellets (called

David J. Shetlar, Ohio State University Extension, Ohio Agricultural Research and Development Center, Associate Professor of Urban Landscape Entomology; Daniel Digman, Research Associate, Department of Entomology, The Ohio State University; Jennifer Andon, Graduate Research Assistant, Department of Entomology, The Ohio State University; Wade Pinkston, Research Associate (former), Department of Entomology, The Ohio State University.

frass) behind. By June, the larvae will have burrowed downward to the grass plant's crown.

If drought conditions exist, this plant and all its tillers will collapse and die. If adequate water is present, the new tillers set roots and fill in where the parent plant was destroyed, thereby covering up any visual damage.

Materials and Methods

In September of 2001, we seeded a "billbug ranch" at The Ohio State University/ Ohio Turfgrass Foundation (OSU/OTF) Turfgrass Research Facility in Columbus, Ohio, which was first used in 2002. This consists of a 125 foot square area of turf that contains some of the early, thick-stemmed cultivars of Kentucky bluegrass (Baron and Marion). By irrigating this area on a regular basis, we are able to maintain high billbug populations yet keep turf death to a minimum. This is the area where we perform most of our control trials.

Test areas are usually divided into 6' x 6' treatment plots, and the slate of treatments is replicated four times in a randomized complete block design. Liquid treatments are usually applied with a four-foot-wide spray boom using a CO_2 pressure tank system that can deliver spray volumes of 1.0 to 3.0 gallons of mix per 1,000 ft^2 (depending on individual protocols). Granular (dry) products are applied by hand through shaker jars. Most treatments are usually followed by a light to moderate irrigation according to each protocol (see tables).

Populations are sampled after treatments (usually early July) by taking a "biased" sample. Within the center 4' x 4' area of each plot, four attempts to pull stems to detect billbug frass are made. If billbug frass is detected within stems, a 4.25-inch diameter golf course cup cutter is used to extract a turf plus soil core from that spot. If no stems with frass are found, the cores are taken at random from within the plot.

Three to four cores are usually taken from each plot unless low numbers of billbugs are found, at which time additional cores may be taken. Each core is individually broken apart in a plastic dishwashing pan and all billbug larvae, pupae, and adults are put into a cup for counting. Counts of billbug stages are recorded for each core sample taken.

In 2002, a second generation of billbug larvae was noticed, so a late rescue treatment was applied (Sept. 13). White grubs were also found in this plot, so a standard white grub evaluation technique (e.g., taking three 7" by 7" turf squares across each plot) was used, and both billbugs and white grubs were counted.

Treatment strategies were generally preventive (applications made before or during egg lay — early to mid-May) and curative (applications made after egg hatch, but before larval pupation — late May into mid-June).

Results

In the 2002 rescue treatment (Table 1), no treatment resulted in significant reduction of billbug populations, but the Arena (=clothianidin) treatment provided quite good control of the white grubs present (Table 2).

Merit (=imidacloprid) has replaced diazinon as an industry standard for control of bluegrass billbug. In our studies, Merit has consistently provided excellent preventive and curative control of bluegrass billbug when applied at the home-owner product rates (e.g., 0.25 lb. AI/acre) and commercial rates (e.g., 0.3 and 0.4 lb. AI/acre) (Tables 4, 5, 7, 8, & 9).

Table 1. "Rescue" Treatments for Bluegrass Billbug Control. Larvae, Pupae, and Adults Recovered at 7 DAT from Treated Bluegrass Plots, OSU-OTF Turfgrass Facility, Columbus, Ohio, 2002.

Treatment/A Formulation	Rate lb AI/A	Avg. Billbugs per cft^2	Percent Control
Arena 50WDG	0.40	7.00	32 a
Meridian 25WG	0.26	8.00	23 a
Dylox 80SP	8.00	9.00	13 a
Sevin 45L (2F)	8.00	9.00	13 a
Check	---	10.33	--- a

[a] Treatments applied Sept. 13 to plots 5 x 10 ft, replicated 4 Xs.
[b] Data taken on Sept. 20 (7 DAT) from three 7-in by 7-in samples from each plot.
[c] Totals per plot analyzed by ANOVA (P >0.5, not significant). Percent controls followed by the same letter are not significantly different using LSD at ≤ = 0.05.

Table 2. Effects of "Rescue" Treatments Made for Billbug Control on White Grub Larvae, Recovered at 7 DAT from Treated Plots, OSU-OTF Turfgrass Facility, Columbus, Ohio, 2002.

Treatment/A Formulation	Rate lbAI/A	Avg White Grubs per cft^2	Percent Control	
Arena 50WDG	0.40	1.67	88	b
Meridian 25WG	0.26	9.33	33	ab
Dylox 80SP	8.00	10.33	26	a
Sevin 45L (2F)	8.00	7.33	48	ab
Check	---	14.00	---	a

[a] Treatments applied Sept. 13 to plots 5 x 10 ft, replicated 4 Xs.
[b] Data taken on Sept. 20 (7 DAT) from three 7-in by 7-in samples from each plot.
[c] Totals per plot analyzed by ANOVA (P = 0.049). Percent controls followed by the same letter are not significantly different using LSD at ≤ = 0.05.

Talstar (=bifenthrin) is often considered to be a replacement for Dursban (=chlorpyrifos) as an adulticide (early preventive) treatment. Our studies confirm that Talstar is an adequate control material when used in this manner (Table 8, May 11 application), but has been consistently inadequate when used past this time period (Tables 3, 5, 7, and 9, mid-May into June applications).

MACH2 (=halofenozide) was only used once in these studies (Table 4), and it continued to perform poorly. We have a field study from 1999 where MACH2 gave excellent control when applied May 7 (81%) and June 11 (89%), but all subsequent applications have resulted in unsatisfactory control.

The newest insecticide registered for turfgrass use is Arena (=clothianidin), another neonicotinoid. Arena has provided consistently excellent control, both as preventive and curative applications (Tables 4, 6, and 9). Arena has provided excellent control of billbugs when used at 0.2, 0.3, and 0.4 lb. AI/acre rates. The

current label allows use from 0.2 to 0.33 lb. AI/Acre with a maximum of 0.4 lb. AI/ Acre per year, and our data suggests that the lower rate is satisfactory for billbug control.

Allectus is a newly registered combination product (contains imidacloprid plus bifenthrin), and our studies suggest that there may be little advantage in using this combination over using Merit alone (Tables 5 and 9).

The newest insecticide being developed by DuPont is still a numbered compound (=E2Y45) that is not a neonicotinoid, but whose characterization has yet to be completed. However, preliminary studies have allowed the US-EPA to declare that the active ingredient is a "low risk" molecule. In our studies, this molecule has produced outstanding control of bluegrass billbugs in preventive and curative studies (Tables 3, 7, and 8) even at relatively low rates (at and below 0.2 lbAI/Acre).

A new botanical insecticide (Facin) was evaluated in 2004 (Table 6), but it did not provide satisfactory control of this pest.

In our studies, excellent control of bluegrass billbugs provided by Merit, Arena, and DuPont E2Y45 as preventive and early curative treatments suggests that these products can be applied in mid-May into early June and achieve subsequent control of annual white grub species, especially masked chafer and Japanese beetles.

Table 3. Bluegrass Billbug Larvae + Pupae + Adults Recovered at 38 DAT from Curatively Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2003.

Treatment/A Formulation	Rate lbAI/A	Avg. Billbugs/cft[2]	Percent Control	
DuPont Exp A 0.4G	0.44	12.69	46	b
DuPont Exp B 0.2G	0.22	10.15	57	b
DuPont Exp 128 EC	0.44	11.00	54	b
DuPont E2Y45 0.4G	0.44	1.69	86	c
DuPont E2Y45 0.2G	0.22	1.69	86	c
Talstar EZ 0.2G	0.10	13.53	43	b
Check	---	23.68	---	a

[a] Treatments applied June 6 to plots 6 x 6 ft, replicated 4 Xs.
[b] Data taken on July 14 (38 DAT) from three 4.25-in cores from each plot.
[c] Totals per plot analyzed by ANOVA (P <0.001). Percent controls followed by the same letter are not significantly different using LSD at ≤ = 0.05.

Table 4. Bluegrass Billbug Larvae + Pupae + Adults Recovered at 61 and 41 DAT (Preventive or Curative, Respectively) from Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2003.

Treatment/A Formulation	Rate lb AI/A	Avg. Billbugs per cft^2	Percent Control	
Merit 0.2G (16 May)	0.25	11.84	70	bc
MACH2 1.5G (16 May)	2.0	19.45	51	b
Arena 0.2G (16 May)	0.20	6.77	83	c
Arena 0.2G (16 May)	0.30	4.23	89	c
Arena 0.2G (16 May)	0.40	1.69	96	c
Merit 75WP (6 June)	0.30	3.38	91	c
Merit 75WP (6 June)	0.40	0.00	100	c
Check	---	39.75	---	a

[a] Treatments applied May 16 or June 6 to plots 6 x 6 ft, replicated 4 Xs.
[b] Data taken on 17 July (61 & 41 DAT) from three 4.25-in cores from each plot.
[c] Totals per plot analyzed by ANOVA (P<0.001). Percent controls followed by the same letter are not significantly different using LSD at @ = 0.05.

Table 5. Bluegrass Billbug Larvae + Pupae + Teneral Adults Recovered at 35 DAT from Late Preventive Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2004.

Treatment/A Formulation	Rate lbAI/A	Avg. Billbugs per cft^2	Percent Control	
Allectus 0.2G	0.18	3.40	79	a
Allectus 0.2G	0.28	7.60	53	b
Allectus 0.2G	0.36	13.50	16	ab
Allectus 0.2G	0.45	3.40	79	b
Talstar EZ 0.2G	0.10	11.00	32	b
Talstar EZ 0.2G	0.20	13.50	16	a
Merit 0.5G	0.30	0.80	95	b
Check	---	23.68	---	a

[a] Treatments applied May 27 to plots 6 x 6 ft, replicated 4 Xs.
[b] Data taken on July 1 (35 DAT) from three 4.25-in “biased” cores taken from each plot.
[c] Totals per plot analyzed by ANOVA (P = 0.015). Percent controls followed by the same letter are not significantly different using LSD @ 0.05 = 2.746.

Table 6. Bluegrass Billbug Larvae + Pupae + Teneral Adults Recovered at 36 and 17 DAT (Preventive and Curative, Respectively) from Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2004.

Treatment/a Formulation	Rate lbAI/a	Avg Billbugs Per cft²	Percent Control	
Arena 50WP(27 May)	0.2	0.00	100	c
Arena 50WP(27 May)	0.3	0.00	100	c
Arena 50WP(27 May)	0.4	0.00	100	c
Arena 0.5G(27 May)	0.2	0.00	100	c
Arena 0.5G(27 May)	0.3	0.00	100	c
Arena 0.5G(27 May)	0.4	0.00	100	c
Facin (15 June)	8.5oz	15.25	38	b
Facin (15 June)	17.0oz	14.48	41	b
Merit 0.5G (27 May)	0.4	0.00	100	c
Check	---	24.58	---	a

[a] Treatments applied June 27 or 15 to plots 6 x 6 ft, replicated 4 Xs.
[b] Data taken on July 2 (36 and 17 DAT) from three 4.25-in "biased" cores taken from each plot.
[c] Totals per plot analyzed by ANOVA (P <0.001). Percent controls followed by the same letter are not significantly different using LSD @ 0.05 = 1.721.

Table 7. Bluegrass Billbug Larvae + Pupae + Teneral Adults Recovered at 51, 16, and 7 DAT (Preventive, Curative, and Rescue, Respectively) From Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2004.

Treatment/A Formulation	Rate lbAI/A	Avg. Billbugs per cft²	Percent Control	
DuPont E2Y45 (11 May)	0.11	8.46	58	bcde
DuPont E2Y45 (11 May)	0.44	0.85	96	e
Talstar F (11 May)	0.10	5.07	75	cde
Merit 75W (11 May)	0.30	3.38	83	de
DuPont E2Y45 (16 June)	0.11	6.76	67	bcde
DuPont E2Y45 (16 June)	0.44	6.76	67	bcde
Talstar F (16 June)	0.10	14.37	29	abcde
DuPont E2Y45 (25 June)	0.11	23.68	0	a
DuPont E2Y45 (25 June)	0.44	20.29	0	ab
Talstar F (25 June)	0.10	16.91	17	abcd
Bayer 24 hr grub (25 June)	8.7	17.76	13	abc
Check	---	23.68	---	ab

a Treatments applied May 11, June 16, or June 25 to plots 6 x 6 ft, replicated 4 Xs.
b Data taken on July 2 (51, 16, and 7 DAT) from three 4.25-in "biased" cores taken from each plot.
c Totals per plot analyzed by ANOVA (P = 0.013). Percent controls followed by the same letter are not significantly different using LSD @ 0.05 = 4.033.

Table 8. Bluegrass Billbug Larvae + Pupae + Teneral Adults Recovered at 57 DAT from Preventively Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2005.

Treatment/A Formulation	Rate lb AI/A	Avg. Billbugs per cft^2	Percent Control	
DuPont E2Y45 1.67SC	0.1	12.1	69.4	b
DuPont E2Y45 1.67SC	0.2	10.2	74.2	bc
DuPont E2Y45 1.67SC	0.25	8.2	79.0	bc
DuPont E2Y45 1.67SC	0.3	4.4	88.7	bc
DuPont E2Y45 1.67SC	0.35	3.8	90.3	bc
DuPont E2Y45 1.67SC	0.4	0.6	98.4	c
Talstar One 0.67F	0.1	10.1	75.8	bc
Merit 75WP	0.3	1.9	95.2	bc
Check	---	39.3	---	a

[a] Treatments applied May 10 to plots 6 x 6 ft, replicated 4 Xs.
[b] Data taken on July 6 (57 DAT) from four 4.25-in "biased" cores taken from each plot.
[c] Totals per plot analyzed by ANOVA (P < 0.001). Percent controls followed by the same letter are not significantly different using LSD @ 0.05 = 4.18.

Table 9. Bluegrass Billbug Larvae + Pupae + Teneral Adults Recovered at 43 and 22 DAT (Late Preventive and Curative, Respectively) from Treated Plots, OSU-OTF Turfgrass Research and Education Center, Columbus, Ohio, 2005.

Treatment/A Formulation	Rate lbAI/A	Avg. Billbugs per cft^2	Percent Control	
Allectus 0.81 SC (May)	0.2	25.40	18.0	ab
Allectus 0.81 SC (May)	0.3	8.20	73.5	cd
Allectus 0.81 SC (May)	0.4	1.90	93.9	d
Allectus 0.81 SC (May+June)	0.2+0.2	5.70	81.6	cd
Merit 2F (May)	0.2	8.90	71.4	cd
Merit 2F (May)	0.25	8.90	71.4	cd
Talstar One 0.67F (May)	0.1	19.70	36.7	abc
Talstar One 0.67F (May)	0.2	14.60	53.1	bcd
Arena 50WDG (May)	0.2	0.00	100.0	d
Check	---	31.10	---	a

[a] Treatments applied May 24 (and June 15) to plots 6 x 6 ft, replicated 4 Xs.
[b] Data taken on July 7 (43 and 22 DAT) from four 4.25-in "biased" cores taken from each plot.
[c] Totals per plot analyzed by ANOVA (P = 0.002). Percent controls followed by the same letter are not significantly different using LSD @ 0.05 = 5.86.

,,,

~ 20 ~
Fungicides Evaluated in 2004 for the Control of Red Thread in Perennial Ryegrass

J. W. Rimelspach, T. E. Hicks, and M. J. Boehm

This test was conducted in 2004, at The Ohio State University Turfgrass Research Center, Columbus, Ohio, on a stand of perennial ryegrass (Lolium perenne) consisting of a blend of three cultivars, 'PS-8990,' 'Buccaneer,' and 'Boardwalk,' at one third each, established in 1994. The mowing height was 3.5 in., and clippings were returned to the site. The area was not irrigated. The condition of the turf was fair, with no thatch and a thin density. No fertilizer was applied in 2004 prior to the study. The soil was Crosby B silt loam, pH 7.3. Individual plots measured 6 ft x 10 ft, with 2 ft between blocks, and were arranged in a randomized complete block design with three replications. Treatments were applied with a hand-held, CO_2-powered boom sprayer, with 6503 TeeJet nozzles at 40 psi (water equivalent to 2.0 gal water/1,000 sq ft). Applications were started on April 29, except for the Endorse treatments, which were started on May 4. The plots were rated by visual assessment as a percent of plot area blighted by red thread on a linear 0 to 100% scale, where 0 = no blighted turf and 100 = entire plot blighted. Analysis of variance was performed with least significant difference at the $P \leq 0.05$ level.

Environmental Conditions at Time of the Study Were:

	April	May	June
Average high temperature (F)	62.4	76.8	79.9
Average low temperature (F)	41.7	55.7	58.8
Rainfall (inches)	4.3	7.1	3.5

Red thread (Laetisaria fuciformis) developed in mid-May in the area from natural inoculum. The disease was active for several weeks and then dissipated by mid-June. Treatments were initiated prior to disease symptom development so this was a preventative fungicide evaluation. The Insignia and Endorse treatments gave excellent results. All treatments, except for Flutriafol, had significantly less disease than the check on the June 2 evaluation.

Joseph W. Rimelspach, Department of Plant Pathology; T. E. Hicks, Department of Plant Pathology, The Ohio State University; and M. J. Boehm, Department of Plant Pathology, The Ohio State University.

Treatment, Formulation, and Rate per 1,000 Sq Ft	Application Interval (Days)	% Plot Blighted by Red Thread		
		May 4	May 27	June 2
Untreated	-	0.0	9.3	8.0
Flutriafol 1.25SC 1.2 fl oz	14	0.0	4.3	2.0
Flutriafol 1.25SC 1.2 fl oz	28	0.0	6.3	5.7
Insignia 20WG 0.5 oz	Single app	0.0	0.0	0.0
Insignia 20WG 0.9 oz	Single app	0.0	0.0	0.0
Bayleton 50WP 0.5 oz	14	0.0	1.7	0.0
Bayleton 50WP 1.0 oz	Single app	0.0	0.3	0.7
Endorse 2.5WP 4.0 oz	14	0.0	0.0	0.0
Endorse 11.2DF 0.9 oz	14	0.0	0.0	0.0
LSD - $P \leq 0.05$		0.33	7.97	6.45

’’’

~ 21 ~

Nursery Foliar and Ground Deposition With an Air Blast Sprayer

Heping Zhu, Richard C. Derksen, Charles R. Krause,
Michael E. Reding, and Randall H. Zondag

Introduction

Applications of pesticides and other production strategies have ensured adequate and high-quality food, fiber, floral, and nursery crops to meet the wide variety of canopy structure characteristics, growing circumstances, and marketing requirements. Transport of spray to target plant surfaces with high-quality atomization is essential to ensure effective spray application in crop protection.

Little information is available on nursery crop production practices whereby applications of required amounts of pesticides achieve effective pest and disease control with minimum chemical loss.

Spray trials with drift retardants or air induction nozzles used for nursery tree applications have not been reported in the literature. Questions remain whether drift retardants and air induction nozzles have advantages over conventional nozzles in field crops and nurseries, and whether performances similar to air induction nozzles can be achieved by using conventional nozzles with larger orifices and/or operating the sprayer at lower pressure.

Drift retardants were reported to reduce spray drift in many laboratory studies. Laboratory tests indicated that drift retardants could increase the volume median diameter of spray droplets initially, but most polymer-based drift retardants lost effectiveness when recirculated through pumps (Reichard et al., 1996; Zhu et al., 1997). Although there are some disadvantages associated with adding drift retardants to spray mixtures, some nursery growers have expressed interest in using these chemicals if they can reduce potential drift damages to adjacent crops or contamination of nearby residential areas.

During the past decade, several types of hydraulic low-drift nozzles (also called air induction nozzles) were introduced into the market for improving pesticide delivery methods and reducing drift. Most air induction nozzles were configured with two small holes on the nozzle chamber upstream from nozzle orifices. These nozzles have been reported to produce higher volume deposits in lower

Heping Zhu, Application Technology Research Unit, USDA-ARS, Wooster, Ohio; Richard C. Derksen, Application Technology Research Unit, USDA-ARS, Wooster, Ohio; Charles R. Krause, Application Technology Research Unit, USDA-ARS, Wooster, Ohio; Michael E. Reding, Research Entomologist, USDA Application Technology Research Unit (ATRU), Ohio Agricultural Research and Development Center (OARDC), The Ohio State University, Wooster, Ohio; and Randall H. Zondag, Extension Educator, Ohio State University Extension, Lake County.

parts of canopies (Zhu et al., 2004) because they could produce a greater proportion of large droplets than conventional hydraulic nozzles. Some reports indicated these low-drift nozzles did not significantly reduce drift in orchards.

The objective of this research was to compare canopy and ground spray deposits from an air blast sprayer with conventional hollow-cone nozzles, conventional hollow-cone nozzles applying a drift retardant spray, and air induction nozzles under nursery field conditions, in an effort to reduce pesticide use in nursery applications.

Materials and Methods

A model 1500 air blast sprayer (Durand-Wayland, Inc., LaGrange, Ga.) was used and operated with five identical nozzles equally spaced on one side of the 36-inch diameter air deflector. The sprayer produced 130 ft/s average air velocity near the nozzles when operated at the high gear setting.

Spray deposits within crabapple tree canopies and on the ground were compared with three different spray treatments — hollow-cone nozzles with water only (HC), hollow-cone nozzles with water and a drift retardant (HCDR), and air induction nozzles with water only (AI).

Nozzles used for HC and HCDR were five conventional hollow-cone nozzles (D5-45, Spraying Systems Co., Wheaton, Ill.) and nozzles used for AI were five flat fan air induction nozzles (AI110-08, Spraying Systems Co., Wheaton, Ill.). The flow rate from the sprayer was maintained at 6.2 gallon/min for all three application methods. The sprayer travel speed was 4 miles/hr at which the application rate was 70 gallon/acre.

Spray deposits within tree canopies, under the sprayed trees, and on the ground at different distances from the sprayer were collected with nylon screens, plastic plates, and plastic tapes, respectively. Tests were conducted with two trials at different times during the growing season (Figure 1).

The spray mixture used in the two trials was 3 grams of fluorescent tracer per liter of water for HC, HCDR, and AI. For HCDR, the spray mixture was additionally mixed with STA-PUTTM drift retardant distributed by Helena Chemical Company (Collierville, Tenn.). The drift retardant was a liquid formulation with 1% poly-vinyl polymer as the active ingredient. Concentration of the drift retardant used in the HCDR tank mixture was 0.49% (v/v).

Field target samples were collected 15 minutes after each spray and placed in clean glass bottles in nontransparent boxes. Spray deposits on all sampling targets were washed with distilled water immediately after they were brought to the laboratory, and then were determined with a luminescence spectrometer.

Droplet sizes from nozzles for AI at 120 psi, and HC and HCDR at 240 psi without air assist, were measured with a laser particle/droplet image analysis system. Droplet size distributions were determined 20 inches below the nozzle orifice across the center line of the spray pattern width with 2-inch intervals. A minimum 10,000 droplets were counted at each sampling position for the droplet size distribution analysis.

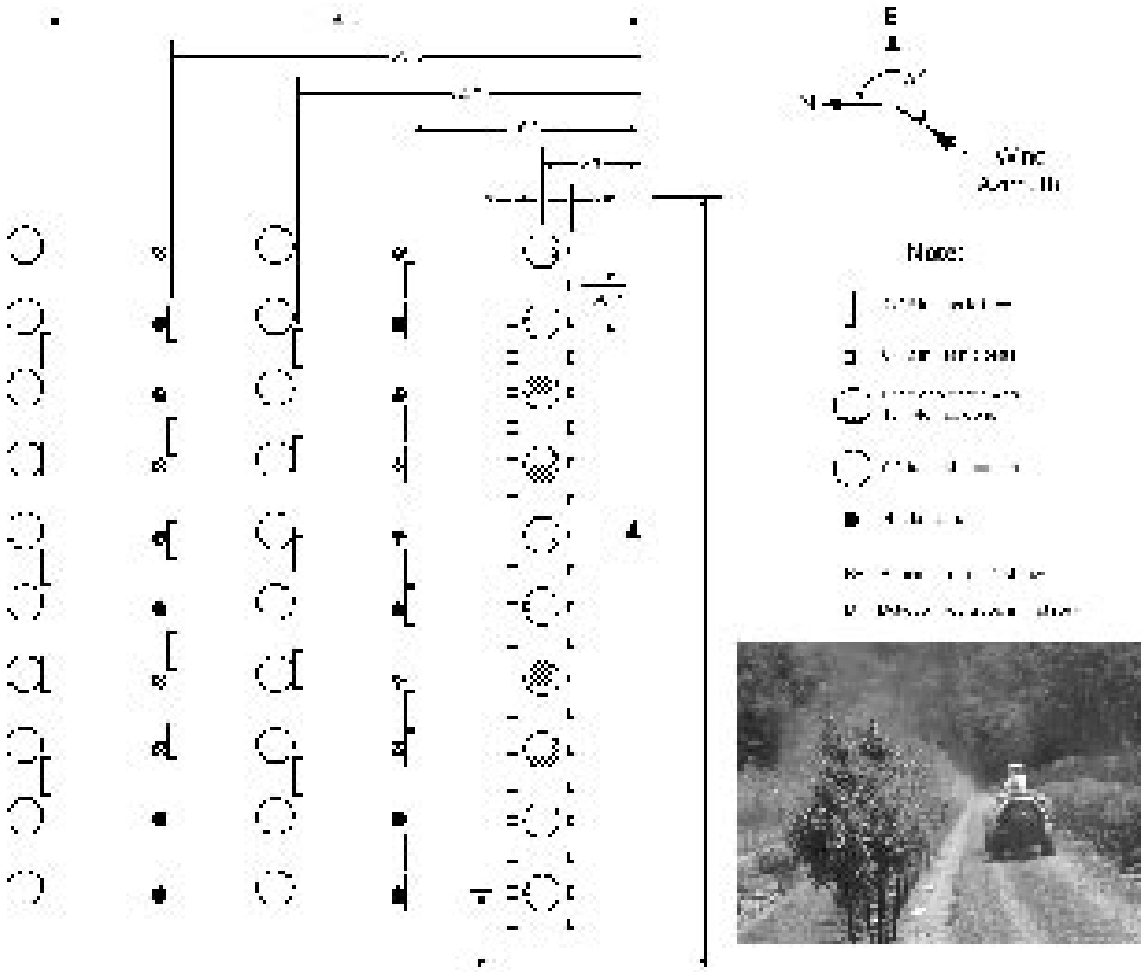


Figure 1. Plan view of spray site showing location of spray collectors downstream from the air blast sprayer for two trials in the field test.

Results and Discussion

Deposits Inside Crabapple Canopies

There were no significant differences in spray deposits on screens at different elevations within crabapple tree canopies among the three spray techniques (AI, HC, and HCDR) in both trials (Figure 2). Therefore, statistically AI, HC, and HCDR treatments produced almost the same quantity of spray deposits within tree canopies. Also, there were no significant differences among deposits at four elevations within the tree canopy for the three treatments.

To produce uniform spray deposits across the tree canopy, air blast sprayers for nursery applications are usually recommended to operate with the same nozzle settings as orchard applications. Specifically, recommendations are to use a larger nozzle at the top of each side, with the capacity of the top nozzle at least three times greater than other individual nozzles. However, results in this study with three different spray techniques showed that spray deposit was uniform across the tree canopy from top to bottom with the equal capacity nozzles on the air blast sprayer. Nursery trees are usually much thinner and sharper with less canopy volume per area than orchard

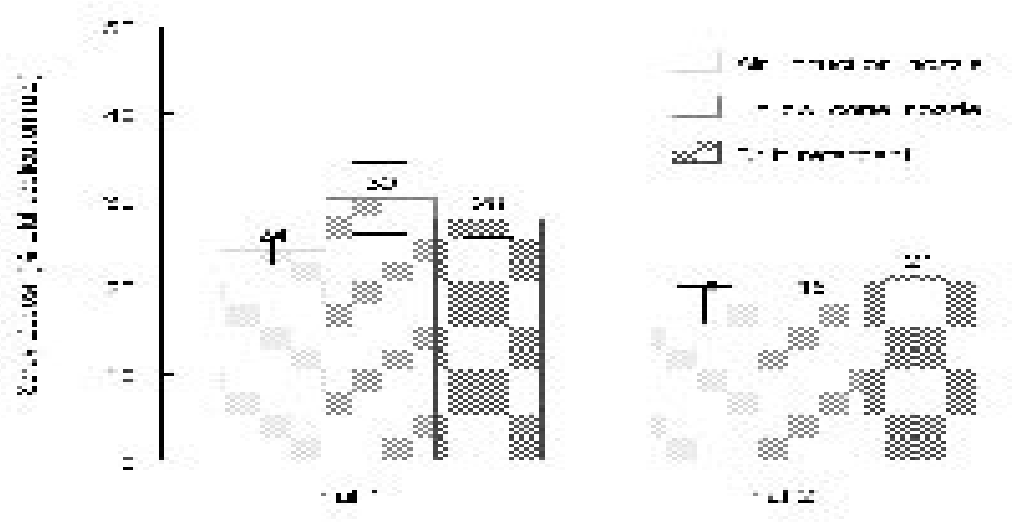


Figure 2. Average percentage of total spray application rate deposited on 12 screen collectors within a tree canopy for 10 crabapple trees. The spray was discharged from the air blast sprayer with AI, HC, and HCDR, respectively. Error bars represent standard deviations of means.

trees. It was reasonable to assume from this study that the sprayer with the equal capacity nozzles had the capability to deliver uniform spray deposits throughout the trees.

Figure 2 also shows average spray deposits in percentage of total spray application rate on nylon screen collectors (simulating leaves) varied from 18 to 30% with the three treatments in two trials. Total spray deposits on screen collectors within a tree canopy were not significantly different among sprays for the AI, HC, and HCDR treatments.

The volume median diameter of water droplets in the main spray sheet from a conventional hollow-cone nozzle at 120 psi was 202 µm (Table 1). The volume of average spray deposit on leaves is equivalent to 2,000 droplets of 202 µm sustained on a 1-square inch area. The recommended droplet density in the target area was from 130 to 190 droplets per square inch for spraying insecticides and 320 to 450 droplets per square inch for spraying fungicides.

The number of 202 µm droplets on tree leaves was 4 to 15 times the number of droplets actually required for the target area. Therefore, tree canopies received excessive spray deposits discharged from AI, HC, and HCDR treatments at the 70 gallon/acre application rate (Figure 3). A typical application rate in commercial nurseries is 100 gallons/acre with the capacity of the nozzles at the top of the sprayer three times the capacity of other individual nozzles. This is similar to the recommendation for orchard applications.

Ground Deposits

Figure 4 shows the average ground spray deposits under the sprayed trees and at different distances from the sprayer with two trials. Statistical analysis indicated that there was no significant difference for ground deposits on targets under the sprayed trees and between two sprayed

Table 1. Droplet Sizes at 20 Inches Below the Nozzle for AI at 120 psi, and HC and HCDR at 240 psi.			
Nozzle	**Average Droplet Size (µm)**		
	DV.1[d]	**DV.5**	**DV.9**
AI[a]	158	407	824
HC[b]	150	202	290
HCDR[c]	157	222	332
[a] AI – Air induction nozzle with water only.			
[b] HC – Hollow-cone nozzle with water only.			
[c] HCDR – Hollow-cone nozzle with water and drift retardant.			
[d] DV0.1, DV0.5, and DV0.9 = Droplet diameters such that 10%, 50%, and 90% of total liquid volume that is in droplets smaller than DV0.1, DV0.5, and DV0.9, respectively.			

Figure 3. Leaves were saturated with spray deposits when 70 gallon/acre rate was applied.

trees for the AI, HC, and HCDR treatments in two trials. Therefore, compared to the total amount of spray deposits on the ground near the sprayed trees, the amount of spray runoff from tree leaves to the ground was not significantly different among the three treatments. The average spray deposit on the ground beneath the sprayed trees was about 24% of the average foliar deposit within tree canopies with AI, HC, and HCDR treatments in two trials.

The average ground deposits collected by the plastic tapes at 15 ft from the

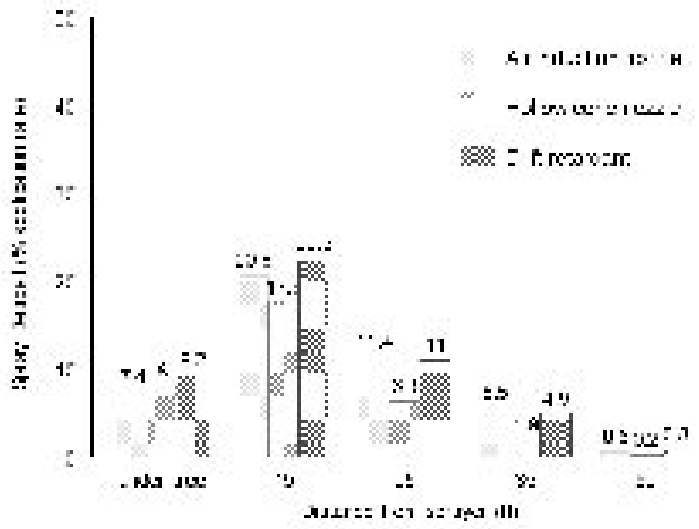


Figure 4. Average percentage of total spray application rate deposited on the ground at different distances from the sprayer for AI, HC, and HCDR, respectively.

sprayer for the two trials with AI, HC, and HCDR were 20.6, 17.6, and 22.5% of the total spray volume, respectively. Also, a considerable portion of the spray volume was deposited on the ground beyond 15 ft from the sprayer (Figure 4). In the three treatments, about 10% of the total spray volume was lost on the ground at 25 ft downstream from the sprayer, about 4% of the total spray volume was lost on the ground at 35 ft from the sprayer, and about 0.5% of the total spray volume was lost on the ground at 50 ft from the sprayer. Therefore, a significant amount of spray volume was lost on the ground with all three treatments at the 70 gallons/acre rate.

Zhu et al. (1997) reported some polymer drift retardants could lose their effectiveness and perform similar to water after two to three recirculations through a centrifugal pump. Likewise, the air induction nozzles did not provide significant drift reduction compared to using the conventional hollow-cone nozzles.

Any droplets larger than 350 µm in diameter from AI, HCDR, and HC would be further broken up by the aerodynamic pressure produced by the parallel air flow from the air blast sprayer. Data in Table 1 illustrate that droplets with more than 50% of spray volume from AI at 120 psi were larger than 407 µm, and more than 90% of spray volume from HC at 240 psi was smaller than 290 µm, and more than 90% of spray volume from HCDR at 240 psi was smaller than 332 µm, respectively.

Obviously, a great portion of droplets from AI in the air blast sprayer might have encountered some breakup due to air shearing effect. Laboratory measurements illustrated that all AI, HC, and HCDR treatments produced nearly 10% spray volume with sizes of droplets smaller than 160 µm (Table 1). Our previous research indicates that droplets smaller than 200 µm are prone to drift. Therefore, AI and HCDR might not achieve their advantages of producing large droplets as normally claimed to reduce drift potential from the air blast sprayer in the nursery field tests.

Summary

1. In general, there was no significant difference for deposits within nursery tree canopies and on the ground by using conventional hollow-cone nozzles, low-drift air induction nozzles, or spray with drift retardants.
2. In nursery application, it was not necessary to place a larger output nozzle at the top of the nozzle manifold on the air blast sprayer as normally recommended for orchard spray applications. Using larger output nozzles at the top of the nozzle manifold may be less efficient and increase spray losses to the ground.
3. Setting up a nursery sprayer using guidelines for semi-dwarf or standard-size orchard trees could result in significant overspray and wasted product. Using the rate of application recommended for orchards in nurseries resulted in more spray deposition within tree canopies than was necessary for good coverage and resulted in excessive spray deposition on the ground. Application rates should be adjusted to provide only the spray coverage needed to achieve the desired pest management.
4. Application rates could be reduced to reduce pesticide waste and labor costs. Growers should experiment with reduced rate applications that better match canopy requirements on a crop-

by-crop basis to evaluate the effect on pest control and crop health.

5. If the application rate is from 70 to 100 gallons per acre (GPA), growers should conduct a test in a small area of their nurseries, where both water and chemical rates are reduced by half for a specific pest or disease control and prevention. Reducing the application rate of a pesticide can be accomplished by mixing a standard spray solution and using smaller nozzles to reduce the spray output while not changing travel speed. That is, the reduced rate of 35 to 50 GPA uses the same chemical concentration as the rate of 70 to 100 GPA. Then levels of control between the small area with the reduced spray rate and other areas with the 70 to 100 GPA application rate should be compared. If there is no difference in the level of control between the two areas, the reduced-rate test can be expanded to larger areas.

Acknowledgments

The authors greatly acknowledge technical assistance by B. A. Anderson, D. Benninger, C. M. Berry, A. Clark, A. A. Doklovic, M. S. Giovannini, L. E. Horst, E. Lu, L. A. Morris, B. E. Nudd, J. Sun, H. Tang, D. T. Troyer, and K. A. Williams in preparing setup and collection of large quantities of samples in the field. Cooperation in providing operating facilities, equipment, and experimental field space by R. S. Lyons, owner, and R. A. Hart, R. G. Headley and J. F. Daley, Sunleaf Nursery, Madison, Ohio, is also gratefully acknowledged.

Disclaimer

Mention of proprietary products or companies is included for the reader's convenience and does not imply any endorsement or preferential treatment by either USDA-ARS or The Ohio State University.

References

Reichard, D. L., Zhu, H., Downer, R. A., Fox, R. D., Brazee, R. D., Ozkan, H. E. 1996. A laboratory system to evaluate effects of shear on spray drift retardants. Transactions of the ASAE 39(6): 1993-1999.

Zhu, H., Dexter, R. W., Fox, R. D., Reichard, D. L., Brazee, R. D., Ozkan, H. E. 1997. Effects of polymer composition and viscosity on droplet size of recirculated spray solutions. Journal of Agricultural Engineering Research 67: 35-45.

Zhu, H., Dorner, J. W., Rowland, D. L., Derksen, R. C., Ozkan, H. E. 2004. Spray penetration into peanut canopies with hydraulic nozzle tips. Biosystems Engineering 87(3): 275-283.

~ 22 ~
Ohio Pesticide Law: Summary of Changes/Requirements for the Landscape, Lawn, and Nursery

Joanne Kick-Raack

New changes to Ohio Pesticide Law and Regulations went into effect on July 1, 2004. These changes primarily altered the licensing of commercial applicators, the licensing of pesticide businesses, and requirements for liability insurance. In addition, some minor changes were made to application record requirements, fees, and other miscellaneous practices and for some specific industries such as termite inspection. The important changes for the nursery and lawn/landscape industries are summarized in this document.

Applicator Licensing

As a result of the law changes, there are now only two pesticide license types in Ohio — private and commercial licenses. Previously there had been a private applicator's license and four types of commercial licenses — custom applicator, custom operator, limited commercial, and public operator licenses.

"A commercial applicator license is now required for 'publicly accessible sites.'"

While applicants for all four commercial license types took the same commercial exams, they paid different fees, and custom applicators carried liability insurance with their license. Now all these licenses have been combined, and the fee has been set at $35 per year.

By definition, commercial applicators include individuals who:

- Apply pesticides for hire such as on lawns or landscapes.
- Use pesticides for any governmental agency such as townships, cities, state, or federal jobs.
- Use pesticides on properties other than those covered for private agricultural use.

The Ohio Department of Agriculture (ODA) also expanded the uses that require a commercial applicator's license to publicly accessible sites defined in law as:

- Golf courses.
- Schools, colleges.
- Child day-care centers.
- Hospitals and medical facilities.
- Rental properties with more than four units at one location.
- Food service operations, retail and wholesale food establishments.

Joanne Kick-Raack, State Pesticide Coordinator, Pesticide Education Program, Ohio State University Extension.

It is very important to note that commercial applicators must be licensed for ANY pesticide use, whether general or restricted-use pesticides are applied. Commercial applicators are held to a higher standard because they are operating around the public and performing applications for hire on other people's property.

As an example, a commercial landscape firm or a school that uses a "weed and feed" product from the local hardware or applies glyphosate products — for example, Round-up (R) — must have licensed applicators or trained servicepersons working under the applicator's license to apply the product even if it is a homeowner product. Fertilizer-only products do not require a license for application.

> "A commercial applicator applies pesticides for hire, uses pesticides for any governmental agency such as townships, cities, states, or federal jobs, or uses pesticides on properties other than those covered by private agricultural use."

For the nursery and greenhouse grower, the private applicator license criteria have not changed. If you are involved in the production of an agricultural commodity, you must obtain a private applicator license to purchase and use restricted-use pesticides (RUP) on your own or your employer's property. Private applicators are not required to have a license for general-use products, but they are encouraged to be licensed. An agricultural commodity can be animals or plants, including nursery stock, sod, fruit, field crops, and more.

Let's look at an example. If a family or a company has both a nursery and a landscape business, those individuals who apply pesticides in the nursery or greenhouse for plant production or to produce sod for sale can be private applicators and are required to be licensed only if they use RUPs. Those individuals who work for hire on lawns/landscapes and apply herbicides, insecticides, or fungicides (including organic products registered as pesticides) must either be licensed or work under the direct supervision of a licensed commercial applicator.

It's also important that licensed applicators are licensed in all the correct categories, whether private or commercial. One individual may have turf, ornamental, and industrial vegetation on his/her commercial license so that he/she can make applications to lawns, ornamental beds, or parking lots. Applicators must be licensed for every site on which they will be applying pesticides.

Check out the Ohio State University Pesticide Education Program web site for licensing and category information at: http://pested.osu.edu.

Direct Supervision

Commercial trained serviceperson requirements stayed basically the same although ODA originally proposed eliminating direct supervision and requiring all commercial applicators to be licensed. The main change was that neither private nor commercial applicators may allow someone under the age of 18 to handle a RUP with the signal word "Danger — Poison" on the label without on-site supervision by a pesticide

applicator. Most products in the landscape and lawn industry do not have such labels. Fumigants used in a nursery or greenhouse operation would carry these signal words.

Commercial applicators should also keep in mind that they carry responsibilities for all trained servicepersons working under their license. They must be under the applicator's "instruction and control." Responsibilities include making sure servicepersons are trained according to the standards and also instructed in any special hazards or precautions.

> "The trained serviceperson must have the pesticide product label at the work site if the licensed applicator is not at the site."

Also, those individuals working under direct supervision must have product labels at the work site if the private or commercial applicator is absent. In addition, the licensed applicator must be accessible (within 25 miles or two hours of the work site). (See the Checklist for Commercial Applicators later in this document.)

This means if your landscape company has one licensed applicator and that applicator goes on vacation, it would be illegal for other trained servicepersons to apply pesticides when the licensed applicator is not accessible.

Trained serviceperson training manuals are available for free in English (Ohio State University Extension Bulletin 863) or Spanish (OSU Extension Bulletin 863-S) from your county OSU Extension office or the Ohio Department of Agriculture.

Business Licensing and Liability Insurance

One of the significant changes in the new law is to strengthen ODA's ability to make commercial businesses responsible for pesticide applications and ensure better oversight of applications. Now, one business license is issued for each company instead of a business license for each location. That business license must list each registered location (branch). And, each registered location must have a licensed applicator. This allows ODA to take action against not only the licensed applicator but a specific branch location or the entire company if they are operating illegally. ODA could now shut down a company's pesticide operations statewide if necessary.

> "A business license is required for companies with commercial applicators and carries the requirement of liability insurance."

In terms of financial responsibility, each business must have a liability policy that specifically provides coverage for pesticide applications and must provide a certificate of insurance to ODA. In the past, some businesses have found out the hard way that their general liability coverage did not cover them for damages or injuries resulting from applications. The minimum coverage limit is $300,000 general aggregate, $300,000 per occurrence limit, and $300,000 products and completed operations aggregate.

Application Records

Commercial

Record-keeping items for commercial applications stayed basically the same except for the statement that you must record "any other pertinent information as required by the pesticide label."

A new requirement is that copies of commercial applications records must be submitted to the pesticide business or employer within 10 days of application. If an inspector makes a visit, he/she will ask to see pesticide records, and they must be at the business location and accessible for review.

As before, records must be kept for three years. (See the checklist for commercial applicator record requirements on page 162.) Commercial applicators must keep records of all applications whether general- or restricted-use products. There is no required form for keeping records.

> "All pesticide application records must be kept for three years for commercial applicators. Private applicators must keep records of restricted-use product applications for three years."

Private

Private applicators are legally required by Federal and Ohio law to keep records of RUPs only, but good records of all pesticide applications are recommended. Records must be kept for three years. However, for agricultural uses such as nurseries and greenhouses, private/commercial applicators also must follow the Worker Protection Standard (WPS) and keep application information on general-use products for the "central information" requirement. Applicators sometimes forget to record "spot" applications of products such as glyphosate. (See the checklist for application information needed for Ohio record-keeping regulations and WPS for private applicators.)

General Safety and Miscellaneous Changes

Water Quality

To protect water, Ohio law now states that pesticide storage areas cannot contain a drain unless it is plugged to prohibit movement of pesticides. Anti-siphon devices must be used if drawing water from surface or public water supplies.

Lawn Notification Rule

> "Any human illness requiring medical attention or property damage in excess of $500 resulting from pesticide applications must be reported to ODA."

For lawn-care applications, the lawn notification rule now requires commercial applicators to include the following statement in information provided to customers: "Lawn posting signs must remain in place for 24 hours following lawn application."

Human Illness or Property Damage

Now private applicators are required to report to ODA any human illness

requiring medical attention or property damage in excess of $500 resulting from their pesticide applications. This requirement was already in effect for commercial applicators.

Summary

This article highlights a number of changes made to Ohio pesticide regulations last year that pertain to private and commercial applicators in the nursery/lawn/landscape business. Also, some key compliance issues are addressed to raise growers' and landscapers' awareness of existing requirements that are often misunderstood.

To view all the actual provisions of Ohio Pesticide Law and Regulations, visit the Pesticide Education Program web site at: http://pested.osu.edu. Click on Commercial Applicator, then Study Materials, and you will find downloadable pdf's under Core Study Materials. However, the checklist presented in this book is a good guide to the key items commercial applicators should address in their daily operations.

> "For more information, visit the Ohio State University Extension Pesticide Education Program web site at: http://pested.osu.edu."

The site has a comparison chart of the items private applicators need to keep for restricted use product application records and the items needed to be displayed at the central information site for the Worker Protection Standard. WPS requires posting of information on general and restricted use products. Again, WPS only applies to applications that are defined as agricultural use. WPS does not apply to residential lawn or ornamental applications or roadside rights-of-way, etc.

For questions regarding upcoming training opportunities, general pesticide information, license applications, or study materials, visit the OSU Pesticide Education Program web site or call the Pesticide Education office at 614-292-4070. For licensing status, forms, or enforcement questions, contact the Ohio Department of Agriculture at 1-800-282-1955.

References

Ohio Pesticide Law, Ohio Revised Code: Chapter 921

Ohio Pesticide Law, Ohio Administrative Code: Chapters 901: 5-11-01 to 901:5-11-99

Ohio Department of Agriculture Regulatory Update. 2004-2005 Summary of Presentations, Ohio Pesticide Applicator Conference. Pgs. 4-10.

Checklist for Commercial Applicators

Licensing

q Obtain an annual Pesticide Business license for firm if apply to another's property for hire or solicit to apply pesticides and keep Pesticide Business license current.

q Register each location used for pesticide business activities on the Pesticide Business license.

q Keep a copy of the Pesticide Business license at each registered location and display it conspicuously.

q Notify ODA of address changes within 15 days.

q Obtain financial responsibility required for Pesticide Business license and have current certificate of insurance submitted to ODA by the insurance company (solicitation to apply requires no certificate of insurance).

q Have one or more licensed Commercial Applicators for each registered location and for firms that conduct other activities that require a Commercial Applicator license (i.e., golf courses, governmental agencies, public and private schools, child day-care centers, food establishments, rental property of more than four units).

q Require Commercial Applicators to have use categories for activities conducted by the firm.

Applicator Records

q Have a record for all applications of pesticides recorded on the date of application.

q Be sure records contain required information:

- Name and address of responsible commercial applicator and name of trained servicepersons applying pesticides.
- Name and address of person contracting for service.
- Type of plants, crops, or animals to be treated.
- Principal pests to be controlled.
- Acreage or number of plants or animals treated.
- Location or field identification number of treatment area.
- Trade name (brand name) and EPA registration number of pesticides used.
- Total amount of each pesticide product used.
- Rate of application and concentration of pesticide formulation applied.
- Type of equipment used.

- Time of day of application, start and completion (or when ceased for the day).
- Wind direction and velocity, air temperature, and other weather conditions when applicable.
- Any other pertinent information as required by the pesticide label.

q Submit records to pesticide business registered location or employer within 10 days of application.

q Pesticide business registered location or employer retains records for three years from the date of application and makes them available to ODA.

Direct Supervision

q Non-licensed users (trained servicepersons) have read ODA's manual Safety Training Guide for Trained Servicepersons or received equivalent employer-sponsored training prior to first occupational exposure to pesticides.

q Each trained serviceperson has signed a written verification along with the immediate supervisor that the manual has been read or equivalent training provided.

q The written verification is available for inspection during the trained serviceperson's employment and for three years following termination.

q Trained servicepersons are acquainted with any special hazards involved with pesticides used and have been instructed in the appropriate precautions.

q Commercial applicator is within 25 miles or two hours time to any for-hire work site for which the commercial applicator provides direct supervision.

q The label of each pesticide used is available at the work site in the absence of the commercial applicator.

Other Requirements

q Use pesticides in a manner consistent with their labeling

q Notify ODA by telephone with 48 hours of any human illness requiring medical attention from or allegedly from a pesticide used by the firm's personnel followed by a written report within seven days.

q Notify ODA by written report within 10 days of any property damage in excess of $500.00 from or allegedly from a pesticide used by the firm's personnel.

q Provide safety equipment required by the label.

q Have an anti-siphon device for equipment that draws water from surface or public water supplies.

- q Have no drain in a pesticide storage area unless it is plugged to prevent movement of pesticide releases.
- q Do not store pesticides above or against sensitive items (feed, food, medications, toys).
- q Do not permit any person under 18 years of age to handle a pesticide with the signal words “Danger — Poison” without on-site supervision by a pesticide applicator.

Recommendations (not regulatory requirements)

- q Storage areas are posted to provide notice that pesticides are stored inside.
- q Spill clean-up materials are available (absorbent materials, Personal Protective Equipment [PPE], plastic bags, shovels, and more).
- q Service containers are labeled with pertinent information such as name of pesticide, EPA Registration Number, and date.

Developed by:
Ohio Department of Agriculture
Ohio State University Extension Pesticide Education Program
12/06/04

Summary of WPS Information and Ohio Record-Keeping Requirements for Private Pesticide Applicators		
Items to Record	**Ohio Private Applicator Record-Keeping** **Restricted-Use Products (RUPs) only**	**FederalWorker Protection Standard (WPS)** **Central Information* Restricted- (RUPs) and General-Use Products**
Date of Application (Mo, Day, Yr)	X	X
Time of Application		X
Target Pest	X	
Pesticide Brand Name	X	X
EPA Registration Number	X	X
Pesticide Formulation	X	
Active Ingredients		X
Rate per Acre	X	
Total Amount of Pesticide Applied	X	
Crop or Site That Received Application	X	
REI (entry restricted until: Month, Day, Time)		X
Method of Application	X	
Size of Area Treated	X	
Location of Treated Area	X	X
Applicator's Name	X (and address)	
Applicator's Certification Number	X	
Type of Application Equipment	X	
Weather conditions, including air temp., wind speed, and direction	X	
*NOTE: WPS information must be displayed before the application takes place if workers and/or handlers are on the agricultural establishment. Kick-Raack, The Ohio State University		

,,,

~ 23 ~

Dawnredwoods and Secrest Arboretum

James A. Chatfield, Anna J. Chatfield, and Kenneth D. Cochran

Featuring: The Secrest Dawnredwood Ambassador, Dr. Burney Huff

"I'm going to look for an ancient tree — be back tomorrow."

These were the words of Del Donahoo on one of his Cleveland-ABC Channel 5 television programs in 2004, Del's Folks. Well, he found his tree —- a living manifestation of it, anyway. He returned to the show with the feathered greenery of that most wondrous of conifers, what the Chinese called shui sha, the dawnredwood, Metasequoia glyptostroboides.

Where did Del get his dawnredwood?

From just down the road from Cleveland, in Wooster, Ohio, at the Secrest Arboretum of The Ohio State University's Ohio Agricultural Research and Development Center (OARDC). More than 6,000 of those dawnredwood seedlings have made their way from Secrest in recent years through sales and as gifts, many due to the efforts of the Secrest Ambassador for Dawnredwood, Dr. Burney Huff.

James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science; Anna J. Chatfield, Student Assistant, Secrest Arboretum and Earlham College; and Kenneth D. Cochran, Secrest Arboretum, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, Ohio.

Burney Huff almost seems to be channeling the feathery foliage and fast-growing upright strength of dawnredwoods, with his own straight tall frame and gentle qualities. Burney is one of a number of people who, over the past six decades, have become enamored of this lovely deciduous conifer, one of the signature trees of Secrest Arboretum (crabapple and silver fir are the others).

To hear Burney hold forth in front of the Secrest dawnredwood grove, with his tales of fossils, dinosaurs, intrepid plant explorers, and the hundred million year ebb and flow of dawnredwoods over the globe, is to be drawn into the growing legions of lovers of this enchanted tree.

Natural History of Metasequoia glyptostroboides

The story begins about 100 million years ago, in the Cretaceous period, about the time that flowering plants (Angiosperms) were starting to emerge, an evolutionary success story that eventually resulted in Angiosperms supplanting Gymnsoperms like dawnredwood as the dominant plants on earth. Dinosaurs were lumbering and darting about. Dawnredwoods held their own, though, as the years swept by, outliving the dinosaurs and eventually spreading over large areas of the earth.

In time, according to paleobotanists, dawnredwood spread from its Asian origins to become the dominant conifer in the Pacific Northwest of what would someday be the United States, varying north to south in distribution over the years with changes in temperature and moisture. But for the past millions of years, those North American dawn-redwoods were absent, with living trees surviving only in moist remote areas of China.

All this we know now only from the fossil record with all of its mysteries and unanswered questions. Burney even has some wonderful rocks with fossil imprints of dawnredwood from the Pacific Northwest. Historic documents of the first order. But even these fossil finds were not known until quite recently in geological times. Let's leap forward to 1941, when a Japanese paleobotanist named Shigeru Miki discovered and correctly interpreted what he was seeing in these fossils.

The fossil cones he saw were similar to Sequoia or Sequoiadendron, the genera that include the coast and giant redwoods of California and Oregon today. But only similar. The fossil cones Miki found were stalked, and the true redwoods do not have stalked cones. The fossilized foliage was feathery, like another tree common to eastern Asia, baldcypress (Taxodium). But the leaves on the fossil shoots were opposite each other, and on Taxodium they are alternate. Miki concluded his fossils were of a different, undescribed plant genus which he named Metasequoia (meta meaning "akin to").

Miki published his findings, and a new genus was accepted by taxonomists. Miki also described four different species of Metasequoia from these fossils. Fascinating, but truly ancient history, since the genus was thought to be extinct by those few scientists aware of Miki's paper. Then, over the next eight years, a series of events in the dawnredwood story unfurled which were, alas, overshadowed by world events — war between China and Japan, World War II, and the emergence of Communist China. Through it all, though, there was a more delightful and modern times botanical tale unraveling.

Later in 1941, a Chinese forester named T. Kan was puzzled by a tree growing near rice paddies adjacent to the village of Modaoqi in the eastern Sichuan province of central China. He was not sure of the tree's identity, but local villagers thought it divine and a predictor of rice harvests. They called it shui sha or water fir. In 1942 another forester named Yang collected seed but was unable to identify the plant either. In 1944 a botanist named Wang thought he knew what the plant was, thinking it a type of Chinese swamp cypress (Glyptostrobus).

Wang sent specimens off to another scientist, W. C. Cheng, who enlisted a graduate student named Xue to do what graduate students do — undertake dangerous, arduous, and tortuous journeys for the glory of science — and a distant degree. Xue braved tough travel conditions and found and collected dawnredwoods, but though he thought the sacred shui sha a new genus, he was not sure what it might be. A paleobotanist named H. H. Hu in Beijing, though, had read Miki's paper and realized the plant was Miki's Metasequoia genus. A plant from the distant fossil record (Miki dated his fossils from Japan at 20 million years old) was suddenly presented as a living tree!

At least it was in the same genus. Hu, though, confronted with the living plant, realized it was a different species of Metasequoia that he had in front of him, as

evolutionary changes had occurred since the days when Miki's had developed. The genus was Metasequoia; Hu completed the Latin binomial with the specific epithet of glyptostroboides, named for the superficial resemblance to the Chinese swamp cypress (Glyptostrobus), which unlike dawnredwood had alternate leaves. And that is how we know dawnredwood today, as the species Metasequoia glyptostroboides. Hu hailed it as the botanical find of the century.

The next chapter of the story was delayed a bit, as conditions in China made it tough for plant collecting. But with the persistence and financial support of Elmer Drew Merrill of Harvard's Arnold Arboretum, Xue set out on expeditions in 1947 and discovered more than 1,000 trees, and eventually more than two pounds of dawnredwood seed were sent to Merrill. In 1948 he then distributed 600 packets around the world to a select group of arboreta, botanic gardens, and other institutions and individuals.

Ollie Diller and Burney Huff

Which brings us, at last to Secrest — and Ollie Diller, the Secrest curator at the time. Ollie was a lover of hollies and many other plants, and, like many to come, became enamored with the dawnredwood. From the seed Ollie received in 1948, he grew seedlings in 1949 from which he took vegetative cuttings in 1951 and then planted out dawnredwoods to a plot along Crumley Road at Secrest in 1953. He also planted dawnredwoods at other locations during this same time period, including at his own house, the homes of friends around Wooster, and others at Secrest, including what is now a majestic specimen near the Arboretum Field Headquarters.

These trees grew rapidly throughout the years as dawnredwood is among the fastest growing of conifers, growing 2 feet a year or more over time. Soon the plot of trees along the newly named Dawnredwood Lane at Secrest were 20, 40, 60, 80, and now in the 100-foot range. People began to admire the feathery green foliage, reddish brown fluted, buttressed trunks, and since dawnredwood is a deciduous conifer, the orangish to reddish brown fall foliage.

Which brings us now to Dr. Burney Huff, a beloved retired Wooster, Ohio, obstetrician. Burney graduated from medical school at Duke University in North Carolina and in 1998 was at a reunion there. In the Duke Gardens are magnificent dawnredwoods planted in the 1950s, with dramatic trunks with telltale armpit depressions in the trunk below branch attachments. He was enchanted by the trees, and returning to Wooster on a visit to Secrest, told the current curator Ken Cochran he needed to get some of these wonderful trees for the Arboretum. Ken took Burney by the arm and said "come with me" and was off to the Secrest Grove, planted by Diller in 1953. The rest is history.

Burney's passion for the dawnredwood has him tracking down all those he sees in the Wooster area, tracing many of them to Ollie Diller's originals, some now in the 80- to 100-foot range. He is there for all of Secrest's events, fascinating all with his tales of this "living fossil" tree, spreading the word just as Merrill did when he introduced dawnredwoods to the West in 1948, and just as Ken Cochran shared the grove on that day seven years ago.

Burney has measured many of the trees with plumb lines; he talks of dawnredwoods to schoolchildren on Arbor Day; he checks out dawnredwoods around the country and has visited plots at Rutgers in New Jersey and elsewhere,

and he is always there for dawnredwood sales and talks at the Arboretum. When he learned of an upcoming trip, he told Jim Chatfield that he must not miss what is thought to be the country's largest dawnredwood, at Bailey's Arboretum on Long Island in New York. And he anxiously awaited the report. The Bailey Metasequoia trees are marvelous.

The Features of Dawnredwood

So what is it that Burney and his converts are so excited about? What are the features of dawnredwoods that intrigue so many? Part of it is the intriguing history of its find when thought long extinct, but another big part of it is that dawnredwood is truly a beautiful tree with many fine features.

Foliage is one-half-inch dark green needles, flat or gently curved at the ends, a little lighter on the undersides. This foliage turns an orange to red brown in the fall and makes the most wonderful soft spun gold straw under the trees. Leaves (and branchlets) are arranged oppositely. The effect of leaves and branchlets provides a fine-textured look to dawnredwood during the growing season.

Bark is a reddish brown aging to softer browns, developing into narrow defoliating cedar-like strips. Over time the trunk becomes buttressed and with a somewhat fluted character. A characteristic of dawnredwood, distinguishing it from baldcypress, is that pit-like depressions develop below the point where branches attach to the central leader.

Growth habit is pyramidal to conical when the tree is young, with variable forms as the tree ages. Some maintain pyramidal shape; others develop a more broadly rounded crown. Most dawnredwoods have dependably straight central leaders. Growth rate is high, and many trees exceed 100 feet with some in the 120 to 140 feet range over the less than 60 years since the seeds from China were distributed worldwide.

Cones are stalked, cylindrical to globose, and small, with stalks 3/4 to 1-3/4 inches long and cones 3/4 to 1-3/4 inches long by about 3/4 inch wide. "Flowers" are monoecious with conspicuous racemes or panicles of male "flowers" developing on the ends of branchlets in fall and female "flowers" solitary and not evident. Cones mature from green to brown. Taxomically, Metasequoia glyptostroboides is one of 629 species in the Order Coniferae, and though long considered to be in the Taxoidiaceae Family, is now categorized in the Cupressaceae.

Where do dawnredwoods grow? Like many plants, especially conifers, they prefer moist, slightly acid soils. They are easy to transplant and do well in locations along streams, and are excellent for parks, as screens, or in groves. Dawnredwoods are an unlikely street tree, but if there is plenty of tree lawn space, soils are good, and utilities are not competing, they can be magnificent.

Dawnredwoods thrive in full sun and require little pruning. Tough winters in northern climes such as Maine can cause problems. Their hardiness zone is Zone 4 southward to Zone 8. Dawnredwoods have very few pests with Japanese beetles minor skeletonizers of foliage, some occasional Dothiorella fungal canker, and reports from old Secrest Arboretum notes in the 1970s of bark stripping by red squirrels. Deer are a problem in establishment years, and protection is often necessary.

Finally, for Burney and for many of us, part of the enjoyment of dawnredwoods is the mystery, the questions that arise about dawnredwood. Why and how did it spread from its Asian origins? Why did

it retreat back to a small area of China? What is it about that small area where the remnant population survived that allowed for its survival? And, why is it now so seemingly easy to grow over a range of habitats where it has been re-introduced? We all love a good mystery.

So what about the future? For dawnredwood it appears to be a growing future as a landscape plant in Ohio and at Secrest. More people are becoming aware of dawnredwoods due to nurserymen and landscapers who also love this plant, and due to ambassadors of Metasequoia like Burney Huff. On second thought, there really is no one like Burney Huff with his personal, playful, and perennial passion for dawnredwoods.

Adding to increasing awareness is the addition of some fascinating variations to the straight species (Metasequoia glyptostroboides). Horticulturists are beginning to identify a number of cultivars that are the result of mutations, including some with golden-colored foliage or white-tipped foliage. Weeping and dwarf dawnredwoods will surely become available.

'Ogon' and 'Gold Rush' are two grafted commercial cultivars planted at Secrest, showing golden leaves, especially on new growth. In addition, as Secrest grows thousands of seedlings, Ken, Burney, and dawnredwood potter extraordinaire Leonard Koch, and Anna Chatfield are always on the look out for something a little different, a brooming of new growth with shorter than normal internodes that may indicate a tendency to dwarfness, different shades of leaf color, and nuances of growth form. Who knows, from these, someday, there may be a new cultivar of dawnredwood that emerges from Secrest Arboretum, just as there is now a 'Secrest' baldcypress cultivar. Metasequoia glyptostroboides — ever-changing, living poetry in motion.

References

Ford, John E. 1982. Dawnredwood. Secrest Arboretum Notes. Summer: 1.

Ford, John E. 1982. Dawnredwood problems. Secrest Arboretum Notes. Summer: 2.

Hendricks, Donald R. 1996. Increasing Genetic Diversity in Metasequoia. American Conifer Society Bulletin 13(1): 7.

Ruggles, Charles. 1999. The Old and the New about Metasequoia: Cultivars Are Coming. American Conifer Society Bulletin 16(1): 7-8.

Sand, Susan. 1996. The Dawn Redwood. East and west cooperated to save this living fossil from extinction. American Conifer Society Bulletin 13(1): 2-6.

Stickel, David. 2000. Deciduous Conifers. Larch (Larix); Dawn Redwood (Metasequoia); Bald Cypress (Taxodium); Golden Larch (Pseudolarix). American Conifer Society Bulletin 17(2): 61-65.

Interested in Planting Dawnredwoods?

If you are interested in planting dawnredwoods, contact Secrest Arboretum Curator Ken Cochran at 330-263-3761 or www.secrest.osu.edu. Check out the Ask the Curator link.

A Voyage In Time

Dawn springs soft green foliage fine
Million times ten times ten years ago
Nyssa Betula cousin Taxodium bald
Companions to shui-sha cool waters flow

From northward south from eastward west
Opposite its leaves opposite its spread
Graceful as music fluted trunks bold
Through ages in warm wet summers it tread

Like redwoods yet unlike swamp cypress it grew
Bright green to pink orange feathers fall
Seeds spread seaward cones round small
Mysterious pyramids growing quickly growing
tall

Winter is stark searching skyward the sun
Fossils tell tales ever eastward return
Wood ages winelike red purples fade
Dawn now is hidden few now can learn

Sun reds crimson arise phoenix anew
From mountain valleys springs forth new birth
Katmandu Hawaii Iceland New Zealand
Secrest the cycle recircles the earth.

— Jim Chatfield

~ 24 ~

The Ohio Maple Syrup Industry: The People, the Practices, and the Value to Ohio

Gary W. Graham, Randall B. Heiligmann, P. Charles Goebel

For many Ohioans a yearly rite of passage starts with a step back in time. As winter's frozen grip gives way to spring's slowly gaining thaw, maple producers, also known as sugarmakers, tap maple trees (mostly sugar maple, Acer saccharum) to produce maple syrup and other maple products. A small portion of the tree's sap is captured and boiled to concentrate the average 2% sugar concentration to a liquid with 66 to 68% sugar concentration. By evaporating off the excess water and concentrating the sugars, sugarmakers produce nature's natural sweetener, Pure Ohio Maple Syrup.

Sugaring is more than just nostalgia and tradition; it provides important supplemental income to thousands of Ohioans. Maple syrup production is an annual $3- to $5-million non-timber forest product within Ohio's economy. Over the past 12 years, Ohio has ranked as the fifth highest producer of maple syrup in the United States, with Vermont, Maine, and New York consistently ranked ahead of Ohio. Even though Quebec alone produces 79% of the world supply of maple syrup, Ohio has continually played an important role in the international maple syrup market, which contributes an annual $150-million boost to the world's economy.

Figure 1. Sugar maple leaf. Note the deep U-shaped notches in the leaf.

Historical Perspective

In 1840, during the first-ever agricultural census conducted as part of the sixth U.S. population census, Ohio was the leading producer of maple syrup, with 6.3 million pounds of sugar or approximately 38% of the U.S. maple market. Today Ohio produces approximately 4% of the U.S. market and just 0.6% of the world market.

Since 1992 the United States Department of Agriculture – National Agricultural

Gary W. Graham, OSU Extension Center at Wooster; Randall B. Heiligmann, The Ohio State University School of Natural Resources; P. Charles Goebel, The Ohio State University School of Natural Resources.

Statistical Service (USDA-NASS) has recorded U.S. maple production as part of the national crop reporting system. Their records indicate that since 1992 Ohio has averaged 75,000 gallons a year (range 55,000 to 95,000 gallons) (see Table 1). In contrast, during that same time period, Vermont has averaged close to a half million gallons of syrup annually.

Ohio's decline in maple production since 1840 is in response to several factors. One of the most important has been the dramatic shift in forest cover. In the mid 1800s, as a result of timber harvesting and land clearing, Vermont and much of the northeastern United States was only 20% forested. However, 87% of Vermont's landscape is now forested, with sugar maple the dominant species. Ohio has essentially experienced the opposite trend. In 1840, at the time of the first census of agricultural products, Ohio was 93% forested. Ohio's forest cover declined to around 10% by 1900 and has since recovered to approximately 30%.

In addition to the dramatic shift in the maple resource, there have been other important factors responsible for the decline in Ohio's maple production. During the late 1800s, the status of maple sugar changed from a staple sweetener to a luxury item as cheaper cane sugar was introduced to the American market.

Figure 2. Maple syrup production region of North America. (North American Maple Producers Manual, Koelling and Heiligmann, 1996. Used with permission.)

Another reason for the decline was the differing roles taken by the various state governmental agencies. While the Ohio Department of Agriculture has not been actively involved in promoting or regulating Ohio's maple syrup industry, the Vermont Department of

Table 1: Average Maple Syrup Production Values From Top Five Producing States From 1992-2005.

	Average Production (gallons)	Average Taps (1,000)	Average Yield per Tap (gallons)	Average Price (per gallon)	Average Value of Crop to State's Economy
Vermont	502,000	2117	0.189	$29.79	$12,311,200
New York	274,000	1306	0.169	$27.97	$6,941,100
Maine	197,500	1088	0.213	$19.68	$1,551,400
Wisconsin	107,800	425	0.175	$26.55	$2,369,200
Ohio	75,000	400	0.184	$33.04	$2,528,900
Source: United States Department of Agricultural – National Agricultural Statistics Service (2005).					

Agriculture has taken a very proactive role in promoting and maintaining Vermont's maple industry. This top-down government support, in conjunction with very proactive independent producer organizations (e.g., Vermont Sugar Makers Association, Vermont Maple Syrup Promotional Board), has resulted in increased market share across the United States, especially in many upscale markets of the northeastern United States.

These aggressive promotional efforts are in strong contrast with the Ohio Maple Producers Association, which promotes Ohio maple syrup on a far less aggressive scale, and with OSU Extension efforts, which have focused on providing education programming on production, management, and marketing practices, but which does not engage in promotional activities. Couple these factors with the fact that Ohio's fertile soil is ideal for row crop production, and it is not difficult to understand why Ohio's maple forests and maple syrup production have declined over the past 150 years.

Researching the Maple Syrup Industry

The diverse forests of Ohio, covering more than 30% of the state, represent a significant and valuable natural resource. More than 97% of these forests are dominated by hardwoods, and the majority of these forests (about 94%) are owned by private landowners. The forest product industry in Ohio, including maple syrup, contributes between $8 and $16 billion to Ohio's economy. Despite these important economic contributions, the potential exists for substantial economic development in the forest products sector.

While USDA-NASS conservative estimates suggest that Ohio maple represents only 0.4% of total economic output provided by the forest products industry in the state, it has the potential to expand dramatically through increased utilization of existing resources and improvements in sugarbush management, syrup production methods, and marketing practices. To accomplish this, however, more information on the maple syrup industry is needed. The only market information that has been available has been the USDA-NASS Annual Crop Reports, which address only the production and crop value of producers who have more than 100 taps.

To begin addressing this lack of information, an extensive survey of Ohio's maple industry was undertaken in 2004-2005 focusing on producer demographics, production practices, and production levels. Over the years researchers have estimated that there are between 1,000 and 1,200 commercial maple producers in Ohio with more than 400,000 taps.

This research was able to identify slightly more than 750 producers, and received usable responses from 620. Maple production was reported in 69 of Ohio's 88 counties, with the highest concentration of operations in northeastern Ohio.

The complete dissertation can be viewed at: http://www.ohiolink.edu/etd/view.cgi?acc%5Fnum=osu1116697646

The Production Practices

Buckets as a collection vessel for maple sap have been used for hundreds of years with the Native Americans using birch bark vessels. Buckets are still used in the entire maple syrup producing region of North America (see Figure 1).

To the surprise of no one, Ohio emerges as a very traditional maple production state, with 78% of the operations classified as bucket collection systems (accounting for 62% of all taps). The remaining

Figure 3. Buckets are the traditional device used to collect sap for maple syrup production.

operations and taps are on tubing systems, a technology that has been commercially available since the early 1970s.

The average bucket operation has 417 taps, ranging from 4 to 5,000 taps, while the average tubing operation has 720 taps, with a range of 12 to 6,500 taps. The larger, traditional 7/16" tap diameter is still the dominant size choice in Ohio, though smaller health spouts with a tap size of 5/16" have been shown to produce comparable volumes of sap with less impact to trees' health.

The majority (79%) of Ohio producers have wood-fired evaporators, and few producers reported having any type of extra attachments on their evaporators designed to improve syrup quality or reduce production time or costs. Sugaring in Ohio remains a very low-tech, high-labor enterprise.

The Demographics

Ninety percent of Ohio's maple sugaring operations are family owned and operated by second generation maple producers. The average producer is a 53-year-old male who has produced for 19 years.

Only 0.5% (n=3) of producers indicated they operated a full-time maple business. The majority (54%) of producers reported they were in agricultural or technical trade-related occupations and used sugaring to provide supplemental income.

Cultural heritage identified 25% of producers as being of Amish descent. Most producers sell their syrup either in retail containers at a variety of venues (farm gate, fairs, craft shows, etc.) or in bulk containers to wholesalers or other retailers.

Most producers do not advertise, as word of mouth brings enough repeat and new customers to exhaust their inventory.

Only 11% indicated they further process the syrup into maple confections. Maple candy is the most common confection produced, but maple syrup is used to produce a variety of other confections, including maple sugar and cream, and is found in the recipes of many food

dishes from beverages to entrees and desserts. In fact, the Ohio Maple Producers Association has recently published a cookbook filled with recipes where maple is a main or key ingredient.

Economic Value of Maple

Based on the 400,000 Ohio taps estimated in this study, each with an average production of 1.06 quarts of syrup per tap per year, Ohio produces approximately 106,000 gallons of maple syrup in an average year. In Ohio a gallon of syrup typically sells for between $25 and $35. When packaged in smaller containers or converted to candy or other confections, a gallon of syrup can bring closer to $65.

Based on this study then, Ohio's maple industry contributes close to 5 million dollars to the state's economy. Both the production rate and economic contributions of Ohio's maple industry found in this research were higher than those reported by USDA-NASS Crop Reporting (75,000 gallons and $2 to $2.5 million).

However, Ohio's maple industry has not really begun to tap its potential. There is still a vast, untapped maple resource in Ohio available to current and potential producers. Further, there would appear to be a far greater market for maple products in Ohio than is currently being reached.

Most Ohio maple producers do not aggressively or creatively market their products, but are satisfied to sell relatively passively from the farm-gate, or perhaps at a fair or craft show. Few venture into the world of corporate gifts, packaged Christmas gifts, mall booths, internet sales, etc. And, while pure maple syrup at $30-plus dollars per gallon may be viewed as a luxury item, few producers have explored ways to most effectively market their products to customers willing and anxious to purchase high quality, natural products.

So, do you have maples you could tap? Are you interested in getting started either as a hobby or as a commercial venture? Ohio State University Extension specialists from the Columbus and Wooster campuses conduct educational programming on maple production and can help answer any questions you may have.

For more information look at the maple fact sheets available free on-line at Ohioline: http://ohioline.osu.edu/ or contact:

Gary Graham (Wooster)
graham.124@osu.edu
330-263-3799
or

Randy Heiligmann (Columbus)
heiligmann.1@osu.edu
614-292-9838.

”””

~ 25 ~

European Hornet (Vespa crabro)

Larry G. Steward

During this past summer of high temperatures, many people have become aware of the flying insects in and around their homes. Some of these insects are not friendly appearing and "must be destroyed!" according to residents. Ohio State University Entomologist Dave Shetlar states, "With the dryer than normal conditions this summer, many of the social and solitary bees and wasps have had little trouble building and maintaining their nests."[1] The European hornet is one of these social insects that develop large paper nests in hollow forest trees or openings in buildings.

This insect is the largest and only true hornet found in Ohio. It is not native but was first reported in the New York in the 1840s.[2] It has spread from New England south to North Carolina and west to the Dakotas. European hornet is frequently found throughout the total northeast and north-central United States. One source states that the European hornet is in every state east of the Mississippi River and found in a few states beyond.[3] Most humans would classify this hornet as a pest, and that anything that stings "has to be killed immediately."

Larry G. Steward, The Ohio State University Agricultural Technical Institute, Horticultural Technologies.

However, the European hornet is considered by entomologists as being a beneficial insect to the human environment. It feeds on live insects such as grasshoppers, caterpillars, flies, and yellow jackets (Vespula maculifrons). The only other predator of yellow jackets known to the author is the skunk. European hornets will also obtain sugars from fruit, honey bee hives, and human's trash. [4]

The European hornet differs from other bees and wasps (Order: Hymenoptera) in that it will fly at night and in the rain. This hornet will over-winter as an inseminated queen in a crevice of a tree or a building or under leaves in the woods. The over-wintering queen can and will be active even on warm days in the mid-winter. The queens emerge in the warm days of early spring and start making nests in hollow trees or walls of buildings.

If the season is warm and very wet, the queen will occasionally build in the open. The queen starts laying eggs that will develop into sterile worker hornets. However, while in the larval stage, the developing worker hornets must be fed by the queen. The material to feed the larval stage is the sap of plants such as rhododendron.[5] Once the workers emerge, the queen no longer leaves the nest. Her purpose then is to lay eggs to enlarge the population of workers in the nest.

Figure 1. The European hornet is not a small insect and can be very intimidating. However, unless its nest is under attack, it is not an aggressive insect.

Eventually she will lay eggs that will develop into males and the next year's queen.

The European hornet is not a small insect and can be very intimidating (Figure 1). However, unless its nest is under attack, it is not an aggressive insect. It is much smaller than the Cicada Killer "Bell Hornet" (Sphecius speciosus) which can reach almost two inches in length with a four-inch wing span.

The European hornet is no more aggressive than the cicada killer. The cicada killer is a solitary wasp that nests in burrows in the ground. This author has personally cut grass in an area that had close to 100 burrows without being stung. The cicada killers would only attack the mowing equipment, not the operator, unlike some of the other wasps.

The European hornet is more like the yellow jacket as it also is a social insect. It is about twice as large as the yellow jacket. However, the yellow jacket is very aggressive and more often finds itself in conflict with humans. The yellow jacket rarely builds its nest above ground. The only time that the author personally has seen the nest above ground was a very rainy summer. The nests were on the soil surface and on lower branches of shrubs.[6]

Aggressiveness of the European hornet is relative to how close the human being is to the hornet's nest. European hornets will defend their nests. They also actively seek out sugars in the form of soft drinks, tea, food, etc., just as their more aggressive relatives — the yellow jacket. This proximity to humans and their activities gets them the reputation as a pest. The yellow jacket, unlike the European hornet, seems to know that the author is quite allergic to venom of its sting. (Of course, that could be the author's imagination.)

The European hornet queen starts making the nest from chewed bark of thin-barked plants such as ash, lilac, birch, dogwood, horse chestnut, boxwood, and rhododendron. As stated earlier, she starts making the nest alone and laying eggs to produce workers. When the workers hatch, the queen feeds them sap from available trees and large shrubs.

This early spring damage has not been recognized or shown in such tomes as Insects That Feed on Trees and Shrubs.[7] This type of damage generally takes place in late winter to early spring in native woodlands rather than in the landscaping material around homes and businesses. The more noticeable summer damage to plants is generally shown in most pest guides, and it will be discussed later.

Homeowners are now noticing this early-in-the-year damage as more people make their homes in native stands of woods in the natural environment of the hornet. This damage is shown in Figure 2 and can be easily overlooked.

The damage appears as if an insect such as a weevil has chewed rings around the plant to obtain sap. The grooves are very narrow and only penetrate as far as

Figure 2. Damage caused early in the year by European hornets feeding on sap from trees in wooded areas. The chewing rings never completely girdle the tree.

Figure 3. Damage caused by European hornets feeding on sap. This photo show damage from multiple years' feeding. The new queen goes to the same tree but feeds in new locations. The fresh chewing is shown at the top; feeding from previous years is shown at the bottom.

the vascular cambium. There are other locations where the damage appears more like ovipositor damage from a beetle or cicada injecting eggs. However, there are no eggs in these grooves, just torn tissue. The chewing rings never completely girdle the stem. Rings overlap but the insect seems to "know" not to kill its source of food.

The hornet queen will secure sap from the plant (in this case Catawba Rhododendron, Rhododendron catawbiense) year after year. The rhododendron will compartmentalize the damage from year to year. When the next generation queen comes the following spring, she will go to the same plant but not the same location on the plant as the prior damage.

Figure 3 shows damage that occurred over several years. Note the old damage below the present year's fresh chewing. The plant has compartmentalized the damage so that the plant can continue to live. The spring damage that the author and others have observed does not kill the rhododendrons.[8] The author had first observed damage three years ago on recently moved, mature rhododendron plants. These plants were taken from building sites in the Wintergreen Resort in Virginia and re-located to the Wintergreen entrance roadside. This fact made them more readily observed and the damage noted. These rhododendrons showed stress from transplanting by backhoe (roughly handled) not from the European hornet. This damage is only observed in the late winter and early spring. The damage does tend to make the trunk unsightly. The owner of the plants became very concerned as to the possibility of loss of the plants. However, no further damage or bark removal was observed during the balance of that year. Further, no other species of plant was observed or recorded in the area with this type of injury.[9]

The next spring and subsequent springs, the same circular spring damage has occurred on the rhododendrons that had been rescued from a building site and re-planted. There has been no loss of plants now that the rhododendrons have become re-established. The hornet damage is on the main trunks and occurs higher each year. Figure 4 shows several damaged

Figure 4. This hornet damage occcurred over a three-year period, beginning at the bottom and moving to the top.

areas that developed over a three-year period.

The author has also observed the same damage on long-established rhododendrons in wild stands in undisturbed woodlands. Consequently, it is not a phenomenon found only on disturbed and weakened plants. Additionally, the author has not observed any breakage or death of the rhododendron trunks over the past three years.

The rhododendron shown in Figure 4 was well established in the wild and not near any area of disturbance by humans. It was healthy and had set flower buds for next year. There is at least three years of hornet damage showing from bottom to top. The plant had none of the typical damage done by the European hornet and shown in photographs. Consequently, the workers were obtaining chewed bark for the nest from other species of plants.

The area near this rhododendron's location is heavily populated with black birch (Betula lenta). This fact could explain the absence of any further damage to the rhododendrons.

The hornet workers move to other plants such as ash, black birch, lilac, and dogwood in order to construct and enlarge the nest. The typical damage done by the hornet shown in most guides and texts shows the damage done by the workers in late summer. This damage totally removes the bark and girdles branches and trunks. The summer damage can kill the host plant, depending on its age and size. Typical summer damage done by the worker hornets on black birch (Betula lenta) is shown in Figure 5.[10]

The author has received a number of "panic" telephone calls in the summer requesting the removal of this "pest." This seems to be the most common time that the hornet is readily observed. This may explain why the publication of illustrations of the hornet's damage includes only this view.

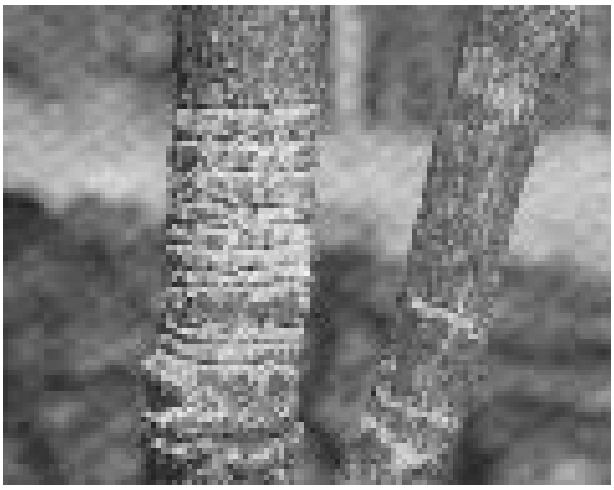


Figure 5. Typical summer damage caused by worker hornets on black birch.

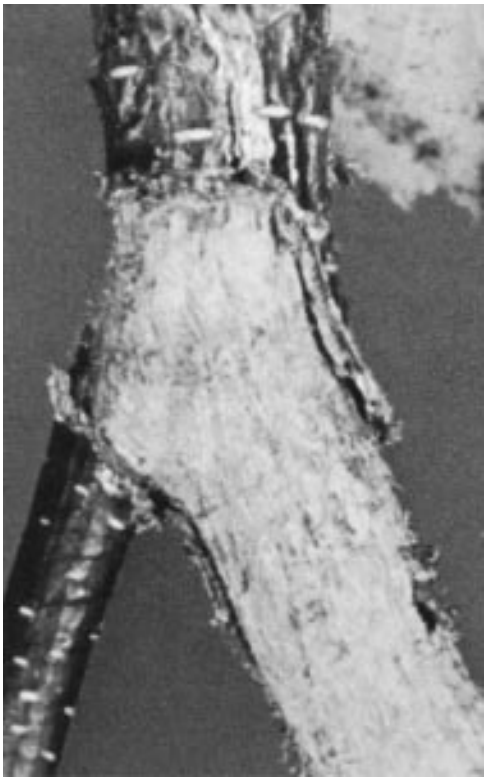


Figure 6. Damage to green ash caused by hornet workers.

The author has observed 10 to 12 workers doing this type of damage to green ash (Fraxinus pensylvanica) in the rain and at dusk. They were not disturbed by my looking at the damage that they caused or by the fact that the author was only six inches from them. They did not become defensive as they appeared to feel that the author was no threat. The opposite feelings were experienced by the author.

The green ash lost several limbs during that season due to their girdling the branches. This tree was not in the woods but was a key shade tree in the front landscape of an expensive residence. The residence was located in a cleared opening in native woodland. The actual nest was over a quarter mile away in a hollow tree.

Some other species of woody plants de-barked by the hornets are common lilac (Syringa vulgaris), dogwood (Cornus florida), horse chestnut (Aesculus hippocastanum), and boxwood (Buxus sempervirens).[11] The author observed in Huron County in August of 2005 this de-barking damage done by the hornet workers, thus confirming the hornet's presence in Ohio. However, to date he has not observed the early spring damage on rhododendron in Ohio but is looking.

There is presently no available control for those who wish to kill this insect. The key for control is finding the nest, not the feeding areas. If the nest is located, powdered Sevin ™ can be placed around the entrance after dark.[12] Then the worker hornets will carry the insecticide into the nest, killing the adults and larva in the nest. Under the cover of darkness there is less chance of the hornet's attacking but not a guarantee. It is really best to have professionals destroy the nest and its inhabitants.

In summary, it has been determined that the European hornet queen does a totally different type of damage than do the hornet workers. The injury is not as damaging or severe as found during the summer on other species of woody plants. Even in stress situations, such as transplanting old plants and under less than ideal conditions, the damage from the queen tends to be more superficial. Possibly it may be more aesthetically unpleasing to the plant's owner than endangering the plant itself.

Footnotes

[1] Dave Shetlar, P.E.S.T. Newsletter, Ohio State University Extension, August 8, 2005.

[2] Bambara, Stephen B., and Waldvogel, Michael, European Hornets, Insect Note-Ent/rsc-11, December 29,1999.

[3] Johnson, Douglas. European Hornet in Kentucky. University of Kentucky College of Agriculture, January, 1994.

[4] Lyon, William F. and Wegner, Gerald S. European Hornet. Ohio State University Fact Sheet HYG-2128-97, 1997.

[5] Tignor, Tim. Forest Health Monitoring Review, Virginia Department of Forestry, Spring 2003.

[6] IBID, #1.

[7] Johnson, Warren T. and Lyon, Howard H. Insects That Feed on Trees and Shrubs. Cornell University Press, pps 436-437, 1976

[8] IBID, #5

[9] IBID, #5

[10] IBID, #7

[11] Day, Eric. European Hornet. Publication 444-240, Virginia Cooperative Extension, August 1996.

[12] IBID, # 3 & # 4.

’’’

~ 26 ~

The Making of a Landscape within Secrest Arboretum

Kenneth D. Cochran and James A. Chatfield

Summary

The Secrest Arboretum is an outdoor research laboratory and display garden which enlarges human understanding of landscape plants through research, education, and landscape beauty. With its location on the Wooster campus of the Ohio Agricultural Research and Development Center and the Ohio State University Extension Center at Wooster, Secrest Arboretum is poised to assume a leadership role for the advancement of knowledge and awareness of environmentally friendly landscape plants.

The significance of flora to the human experience is well known. Improving the quality of life with plants is a creative thrust that significantly surfaced in the mid to late 1960s under the leadership of Mrs. Lady Bird Johnson's National Beautification Program.

Along with that thrust, there developed a widespread involvement in gardening as the No. 1 pastime in the United States, and the fondness for landscapes and the out-of-doors is readily documented. All are expressions of the human response to plants.

The quality of our environment and what people should be doing to ensure its continued viability for future generations should be the primary objective of an arboretum, according to Henry M. Cathey, former director, U. S. National Arboretum, Washington, D.C.

Kenneth D. Cochran, Secrest Arboretum, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, Ohio; and James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science.

Secrest Arboretum will remain viable as a source for research-based landscape solutions as it serves the needs of people through action-oriented arboretum programs, projects, and events that help people discover how their landscapes can make a difference in their communities.

The goal in the making of a landscape at Secrest Arboretum has been to create a landscape discovery grounds incorporating research, education, and landscape beauty programming. Creating a landscape discovery grounds is a response to the need for experiencing science-based information within designed theme landscapes.

Through Secrest's trio of outdoor anchor programs — chats, talks, and walks, along with workshops, seminars, and special events — Secrest will help in linking people to the world of plants. The benefits of this goal will be striking and diverse landscape plantings that adapt to northeastern Ohio's climate, landscape resources for scientific study, and a strengthening of Ohio's economy through a vast system of business enterprises including Ohio's multi-billion-dollar green trades industry.

Background

Plantings of trees and shrubs at Secrest Arboretum have been continuous since 1909, with nursery stock originating from Ohio, the nation, and around the world. In May 1950, the arboretum was named for Edmund Secrest, the first state forester and former director of the Ohio Agricultural Experiment Station, now known as the Ohio Agricultural Research and Development Center (OARDC). OARDC is the research arm of the Ohio State University's College of Food, Agricultural, and Environmental Sciences.

Secrest Arboretum is Ohio State University's leading research arboretum and a premier authority for information about landscape plants. It is a place for researchers to seek, document, cultivate, and evaluate plants for Ohio's landscapes. The extensive, time-honored plant collections capture the diversity and facilitate the study of the plant kingdom.

Researchers, educators, students, consumers, and members of the green trade industry, including nurseries, garden centers, landscape construction and maintenance businesses, and architecture firms, all benefit from the research-based information that Secrest Arboretum provides. Many of these discoveries generate new information. Users gain insight into the science and technology of growing plants to achieve an attractive and functional landscape for home, business, and other landscapes throughout Ohio.

Secrest Arboretum is committed to maintaining its multi-purpose function of offering research, education, and aesthetic value, with free public access.

Methods

…A Feasibility Study with a Task Force Committee Report

In the summer of 1991, the trustees of The George Gund Foundation helped Secrest Arboretum look into its future through a $25,000 planning grant. This grant provided resources for developing an insightful and methodical plan for utilization of the Arboretum's resources and for the future of its research, education, and outreach programs. The George Gund Foundation investment was supported by OARDC's investment of personnel, supplies, and services.

The planning project consisted of the following investigative activities:

- Ten hearings were conducted with respective groups to determine the following:
  - Δ Informational needs of Ohio's green trade industries.
  - Δ The Arboretum's role of serving OARDC through interdisciplinary activities.
  - Δ Informational needs and interests of professional horticulture societies, city planners, garden clubs, and business and professional leaders.
- Twenty-five individuals were identified to represent the following five groups:
  - Δ Business and community leaders of northeastern Ohio, to gain funding support in the long-term.
  - Δ City planners from Ohio's largest cities.
  - Δ Landscape planners.
  - Δ Avid gardeners.
  - Δ Horticulturists from green industries to determine their informational needs.
- OARDC administrators to define or confirm the Arboretum's roles in serving OARDC and to target how interdisciplinary tree and shrub research might be accomplished.

Fact-finding visits were made to four arboreta — Arnold Arboretum of Harvard University, Cornell Plantations, Holden Arboretum, and North Carolina State University Arboretum — to learn how they operate and serve their constituencies and to review their strategic plans.

A Secrest Arboretum Task Force Committee made up of five members met and reviewed the feasibility study and provided an external viewpoint for developing a Strategic and Master Plan for the Arboretum.

…The Strategic Planning Team

A Strategic Planning Committee, consisting of 19 internal and external members, met in January 2000 and continued to meet over the course of 18 months. There was much diversity in the group, with half of the team consisting of members from outside the University.

The team initially reviewed the activities of the Arboretum since 1992, the report of the Task Force Committee, and developed a schematic diagram showing relationships among Secrest Arboretum programs and fiscal resources.

The Committee looked at trends and issues in reference to:

- Physical and human assets.
- Advancement of knowledge.
- Programming options.
- Customers.
- Disseminating and communicating knowledge.

From a list of prioritized trends and issues, they determined the playing field for the Arboretum. They reviewed and developed a mission and a vision statement, collected input from among the expertise that each represented, and wrote strategies for the issues facing the Arboretum.

Their work envisioned a future arboretum that retains its basic research mission, but greatly expands programming to include education and natural beauty and integrates all three functions. They worked on the premise that the Arboretum will become Ohio's and the region's premier authority for information about the culture, maintenance, and use of

landscape plants for research scientists, educators, students, producers, landscape architects, and consumers. Moreover, the Secrest Arboretum, in its second century, is expected to be a primary destination for visitors, not only from Ohio and the Midwest, but the nation and the world.

The Committee developed Arboretum strategies from the belief that there is a collateral benefit in expanding public programming for the Secrest Arboretum. Although the food and agricultural industries make up one of the most important segments of Ohio's economy, contributing $73.3 billion annually (2001), creating one of every six Ohio jobs and 11 percent of total income, few Ohioans are aware of these contributions.

This is especially true of citizens who live in Ohio's many urban and suburban centers. This growing segment of Ohio's population is becoming increasingly interested in ornamental plants and their environment, the focus of programs that will be highlighted in the Secrest Arboretum.

This provides OARDC with an unparalleled opportunity to educate visitors about the entire spectrum of research and educational programs that contribute to Ohio's economic viability; environmental health; production efficiency of food, plants, and animals; and responsibility to the social well-being of its citizens.

…A Landscape Master Plan Developed

A landscape master plan and an estimate of probable cost was developed through a Master Planning Committee and the hiring of Myers Schmalenberger, Columbus, Ohio, and the services of Karen J. McCoy, American Society of Landscape Architects (ASLA.)

In completing a Secrest Arboretum Concept Master Plan, the following tasks were worked through:

I. Site Inventory
II. Master Plan Programming
III. Design Charettes with Master Planning Committee and Town Meetings
IV. Master Plan Development
V. Master Plan Report Preparation
VI. Illustrative Graphics and Brochure.

A wide-ranging group of stakeholders participated in the planning process. Their purpose was to ensure the accomplishment of a shared vision for Secrest Arboretum. The stakeholders offered their visions, hopes, and dreams for Secrest Arboretum.

The Committee and stakeholders guided the architects through the complexities of information gathering, supported their efforts to bring together the many diverse elements into a organized whole, and provided them with a clear sense of the sacred elements of the Secrest Arboretum and the OARDC and Ohio State Agricultural Technical Institute (ATI) campuses.

…A Doable Project Created

In December 2003, John Meyer, acting vice president for development of Ohio State, met with the Secrest Arboretum Council to determine a feasibility project for the Secrest Arboretum in development and utilization of the Master Plan.

The Council and John Meyer developed a Growing for You campaign with priorities for establishing a doable project within two years.

Three phases were created to make the implementation of the Master Plan doable:

Phase One

Landscape Discovery Grounds
$850,000
2004 – 2006

Themed Gardens, Informational and Orientation Kiosks, Educational Pathway, and Education and Outreach programming.

Phase Two

Secrest Center for Landscape Art, Science, and Technology
$3,000,000
2006 – 2009

Building, Programs, Parking, and Landscape.

Phase Three

Water Management and Environmental Impact Research
$2,150,000
2008 – 2010

Lake with storm water retention, ATI and OARDC Campus Connectors, Tree Evaluation Plots.

…A Doable Project Conceived

The design components of Growing for You Phase I were developed through the hiring of Impullitti Landscaping, Inc., Chagrin Falls, Ohio. Details of Phase I were worked out through the Master Planning and Development Committees in working with landscape designer James Arch and through recommendations to the Arboretum Council and to the OARDC Director. Drawings were rendered and a Growing for You brochure was developed with OSU Development, Lisa Welty.

Results

…Of the Feasibility Study

Through the George Gund Planning Grant, project leaders gained input from internal and external constituents and help in integrating the Arboretum's activities with its mission and in shaping guidelines for the Arboretum's resources, programs, and funding challenges.

The perspective on issues of research and development priorities through this feasibility study was valuable in shaping a future work in strategic and master planning. The study served as a road map for using resources wisely, planning programmatic changes, and disseminating research results to the public and to horticultural and environmental professionals.

The feasibility studies addressed how Secrest Arboretum could best accomplish plant conservation, whole plant research and development, and inform people of research results. The 10 hearings with constituents gave different perspectives on the research, funding, and informational programs of the Arboretum. Each constituent group identified its specific needs for landscape horticulture research information.

The four visits to arboreta gave ideas for combining research and demonstration programs, maintaining a strong financial base, involving students and volunteers in Arboretum activities, and building outstanding plant collections.

Based on information provided to the Secrest Arboretum Task Force Committee, recommendations and rationales were made by the Committee on eight issues confronting the Arboretum and actions, with a priority plan for implementation.

During and following the feasibility study, volunteer assistance began to formulate into action and give great assistance and leadership for garden and nursery maintenance and the development of a very successful annual Plant Discovery Day. It took the foresight, determination, hard work, and loyalty of a strong core of 20 volunteers, on the average, working together under the leadership of Jack Miller and Jim Burrill and the steady faithfulness of Richard Kosarko (right up to the day that he passed away) to bring about significant results.

In the 10 years following the Gund planning activity, arboretum programming expanded to include education, outreach, and display gardens targeted for the visiting public.

…Of the Strategic Planning Team

In August 2001, members of a Secrest Strategic Planning Team proposed five strategies to answer the questions posed as strategic issues for the Arboretum. They recommended to the OARDC Director the following five strategies with rationale, functions, responsibilities, completion dates, and review:

- Develop and implement a Secrest Arboretum Board.
- Develop a Master Plan for site and facilities.
- Develop a private funding program.
- Develop a brand-marketing plan.
- Develop a project and grounds management plan.

…Of the Landscape Master Plan

The Landscape Master Plan was completed as a Concept Master Plan and included recommendations for the connectivity of the OARDC and ATI campuses with an estimate of probable cost. Recommendations included the following:

- Establish Secrest Arboretum entrances from Secrest Road.
- Establish Wilson Road and ATI extension roads to Gossard Drive.
- Enhance existing OARDC and ATI entrances with Arboretum plantings.
- Establish service road connections between Secrest Road and Selby Road on Arboretum property east of Routes 83/250.
- Establish off-site way-finding signage to OARDC, ATI, Extension, and Secrest Arboretum.

In addition, the following phases were recommended for Arboretum Development:

Phase I

Proposed Stone House and Rose Garden and Arboretum Enhancement and Connection Plan.

Phase II

Visitors Center, Wetland and Aquaculture Research Display and Research Wetland Development.

Phase III

Research Demonstration Plots.

The total probable cost: $4.5 million.

…A Doable Project Conceived

The components of Growing for You Phase I were developed as follows:

Landscape Discovery Grounds

Discovery Plaza…

The hub of the Landscape Discovery Grounds exhibiting a landscape story line about the art, science, and technology of landscape horticulture and informing visitors about the various theme gardens, plant collections, and research.

Butterfly and Hummingbird Garden…

An aesthetically pleasing and functionally designed outdoor theme garden that serves as a mini ecosystem to lure hummingbirds, butterflies, and other pollinating insects.

Unique Collections Garden…

Grassy areas that are perfect for strolling and admiring planting beds populated with a specialty palette of plants expressing the interests of plant enthusiasts.

Educational Pathway…

A paved pathway that winds through the Landscape Discovery Grounds and connects various gardens and collections.

Woodscaped Songbird Garden…

A dynamic and fascinating community of plants forming a woodscaped habitat necessary to attract a wide variety of songbirds.

Sculpture Interludes…

Focal points that shape the landscape with site amenities and works by renowned artists.

Education and Outreach

A variety of programs, seminars, workshops, tours, and educational materials that stimulate the interaction between Secrest Arboretum and its visitors.

Arboretum Gateway

Entryway…

An attractively landscaped entrance highlighted by improved signage and an expanded parking area.

Orientation Plaza…

An open-air exhibit that offers information and visual ties to the 115-acre Arboretum and display gardens.

Budgeted costs for Phase I Growing for You are $850,000 with money to be raised and construction to be completed in 2004-2006. Cost figures were broken out for Phase I, and naming opportunities for giving were established.

…And for the Future

Secrest Center for Landscape Art, Science, and Technology…

A multi-purpose facility that serves as the centerpiece for indoor/outdoor educational and visitor programs pertaining to the art, science, and technology of the landscape.

The entire Master Plan project for Secrest Arboretum is now estimated at $6 million. This project is a priority for The Ohio State University in Wooster and will be completed in full.

. . .Support for the New Secrest Experience

Through the generosity of private financial supporters, Secrest Arboretum will continue to serve the needs of many people as we work to improve our programs and facilities. Pleasant vistas among open lawns and extensive plant collections, designed landscapes,

educational exhibits and meeting places — all will capture the new Secrest experience.

Secrest visitors will be inspired by and learn best practices in planting and landscape maintenance by studying designed landscapes that have been developed to depict various ecosystems. Growing for You offers programs, seminars, workshops, tours, hands-on learning experiences, and educational material that provides you with unbiased knowledge about landscape plants.

Beautifully themed gardens, illustrating the use of color and texture within plant habitats, will be created according to existing climate and soil conditions.

An ever-growing number of Secrest visitors value both the paved and the grassy areas that wind through plantings and gardening experiences. They enjoy the sights, sounds, and smells in serene expanses of open land, wooded areas, and landscaped research plantings.

Those who wish to make a contribution to Secrest Arboretum Growing for You are encouraged to consider the following donor options — cash, pledges, securities, and planned gifts.

Support for and inquiry about Growing for You can be directed to the Secrest web site, www.secrest.osu.edu and ASK the CURATOR, call 330-263-3761 or OSU Development, Wooster, 330-287-1234.

References

Ohio Agricultural Research and Development Center, The Ohio State University, A Proposal to The George Gund Foundation and the Report of the Secrest Arboretum Task Force Committee, June 4, 1991, and December 1992.

Opportunities for Support of Growing for You, enhancing opportunities in science, discovery, education, beauty, wellness, and economic health presented by Secrest Arboretum and Ohio State University Development, 2004-2005.

Secrest Arboretum Volunteer Membership Directory, 1996, 2000-2001

The Ohio State University, Ohio Agricultural Research and Development Center, Secrest Arboretum, Strategic Plan, August 2001.

Secrest Arboretum Master Plan, MSI, September 2003.

Opportunities for Support of Growing for You, enhancing opportunities in science, education, beauty, wellness, and economic health; presented by Secrest Arboretum, Ken Cochran, and OSU Development, Lisa Welty, 2004-2005

Acknowledgments

The authors thank the following institutions, organizations, and individuals who contributed in various ways to the making of a landscape within Secrest Arboretum:

George Gund Foundation, Cleveland, Ohio

Sandy Lueschen, formerly OSU Development, Wooster

Jack Miller, formerly of Strasburg; Jim Burrill, Wooster; and Richard Kosarko, formerly of Wooster; Burney Huff, Wooster; Leonard Koch, Wooster; and many other volunteers

Secrest Arboretum interns

Secrest Arboretum Task Force Committee

Strategic Planning Committee

Akron Garden Club

Ohio Nursery and Landscape Association and its members who help in many ways

Ohio Landscape Association and its members who help in many ways

OARDC Research Operations, Grounds

Secrest Arboretum Council

Secrest Arboretum Standing Committees; Research, Education and Outreach, Master Planning, Development, Finance, Nominating, Marketing

Chair of the Strategic Planning Committee, Skip Nault, Wooster, Ohio

Chair of the Secrest Arboretum Council, Wolf Schmitt, Wooster, Ohio

Chair of the initial Master Planning committee, Joel Korte, Columbus, Ohio

Lisa Welty, formerly OSU Development

John Meyer, OSU Development

Joe Cochran, Secrest Arboretum

Karen J. McCoy, ASLA, Myers Schmalenberger, Columbus, Ohio

Impullitti Landscaping, Inc., and James Arch

Dave Nielsen, Chair of combined Master Planning and Development

Shawn Cleveland, OSU, OARDC/ATI Development, Wooster

”

~ 27 ~

Ohio State University Extension's Next STEP Initiative

James A. Chatfield, John Conglose, Denise Ellsworth, Timothy J. Malinich, Erik A. Draper, Jack Kerrigan, Kenneth D. Cochran, Davis Sydnor, Drew Todd, Daniel A. Herms, Pamela J. Bennett, Joseph F. Boggs, Amy K. Stone, Dave Civittolo, and Nancy Kukay

The Next STEP Initiative of Ohio State University Extension (OSUE) and OSUE's Extension Center at Wooster is a multi-disciplinary program focusing on the social and economic benefits of urban forests for Ohio communities and citizens, the Ohio green industry, and the furtherance of scientific literacy. Next STEP is an initiative that builds on the horticultural findings of the Street Tree Evaluation Project (OSU STEP) that started in the mid-1960s, adding socioeconomic and cultural components and community-oriented urban forestry research and outreach. Next STEP has several developed and developing components, including:

- The OSU Street Tree Evaluation Program (STEP)
- The New OSU Street Tree Evaluation Project
- The OSU Deciduous Tree Evaluation Plot
- The OSU Master Tree Stewards Master Gardener Volunteer Specialization
- The Next STEP Community Forest Web site

The OSU Street Tree Evaluation Project (STEP)

The Ohio State University Street Tree Evaluation Project (STEP) was started by L. C. Chadwick, Ken Reisch, and others in 1967 and involved evaluating 96 street tree plantings (and thousands of trees) throughout Ohio in the cities of Cincinnati, Cleveland, Columbus, Toledo, and Wooster. Horticultural data and photos

James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science; John Conglose, Ohio State University Extension Center at Wooster, Community Development; Denise Ellsworth, Ohio State University Extension, Summit County; Timothy J. Malinich, Ohio State University Extension, Cuyahoga County; Erik A. Draper, Ohio State University Extension, Geauga County; Jack Kerrigan, Ohio State University Extension, Cuyahoga County; Kenneth D. Cochran, Secrest Arboretum, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, Ohio; Davis Sydnor, The Ohio State University, School of Natural Resources; Drew Todd, Ohio Department of Natural Resources, Division of Forestry, Columbus, Ohio; Daniel A. Herms, Ohio Agricultural Research and Development Center, The Ohio State University, Entomology; Pamela J. Bennett, Ohio State University Extension, Clark County; Joseph F. Boggs, Ohio State University Extension, Hamilton County, and the OSU Extension Center at Piketon; Amy K. Stone, Ohio State University Extension, Lucas County; Dave Civittolo, Ohio State University Extension, Medina County; and Nancy Kukay, Ohio State University Extension, Crawford and Wyandot Counties.

were collected for these plantings in 1967 and for several years after.

Data were not collected again until 1997 when Drew Todd and Dan Balser of the Ohio Department of Natural Resources (ODNR) Division of Forestry contacted Davis Sydnor and Jim Chatfield, and we all revisited those sites. A 30-year perspective of what happened to those 96 tree plantings, complete with before and after photos and growth and survival data, was compiled and published in Bulletin 877-99, Ohio Street Trees Evaluation Project.

This STEP program is ongoing, with another revisit to those sites planned by OSU and ODNR in 2007.

The New OSU Street Tree Evaluation Project

The New OSU Street Tree Evaluation Project was initiated at the OSU Extension Center at Wooster as we reviewed data from the original STEP sites. We realized that simple plant selection decisions have big impacts for communities. Anecdotally, this was driven home best by two very similar neighborhoods in the Brooklyn area of Cleveland.

Both neighborhoods had the same type of tract houses. However, one neighborhood was now delightfully shaded with arched honeylocust canopies, with numerous people outside barbecuing, playing frisbee, and chatting with neighbors.

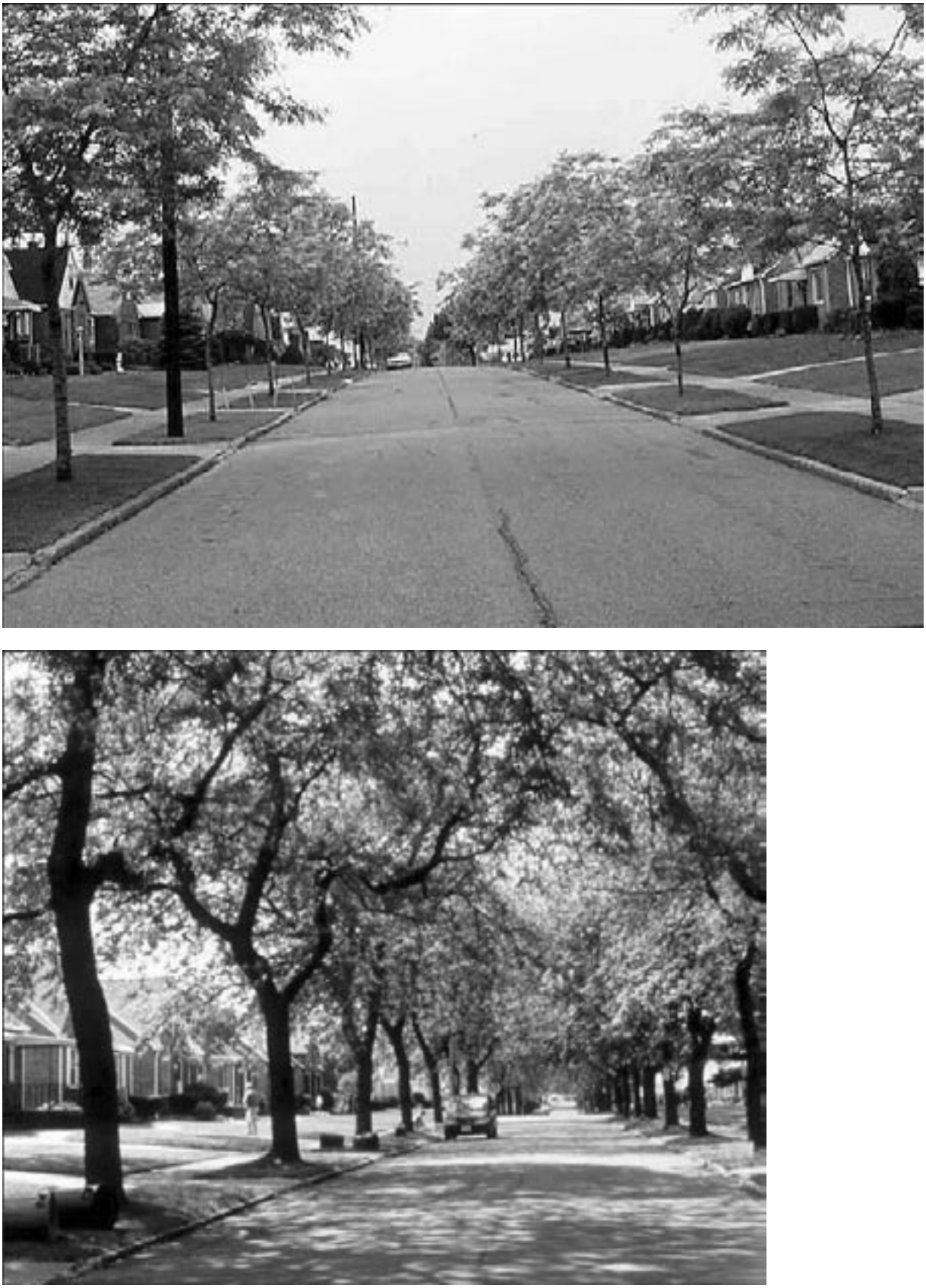
Its alter ego neighborhood appeared to be on its second or third incarnation of scrubby hawthorns, had a barren sun-bleached look, and the only human activity appeared to be the slight suspicious parting of curtains from some of the homes.

They are very different neighborhoods now because of simple plant selection decisions made many years prior.

The punch line to this story is that it would be great to better quantify these long-term effects of plant selection decisions. What is the attitude of homeowners to their community in each of these neighborhoods? How do home values and home sale prices differ for paired neighborhoods with variable street tree plantings?

For new sites, we will consider community development; economic impacts; horticulture and natural resource management; the benefits of urban forests — all together in one long-term project from day one.

Lavalle Hawthorn, Brooklyn, Ohio (Cleveland Area). Top photo shows the trees soon after they were planted in 1968. By 1997, the trees (bottom photo) were scrubby, providing little shade to the neighborhood.



Sunburst Honeylocust, Brooklyn, Ohio (Cleveland Area). Top photo shows the recently planted trees in 1968. Bottom photo shows the same street in 1997, with trees providing an arched canopy and shade for the neighborhood.

The OSU Deciduous Tree Plot

The OSU Deciduous Tree Plot is the planned follow-up to the OSU Shade Tree Plot, developed in the 1960s and decommissioned in the late 1990s as the trees outgrew their researchable size (it continues as a thinned out display plot at Secrest Arboretum). The original Shade Tree Plot was world-renowned. This plot was used by urban foresters in Ohio, nationally, and worldwide and provided key research data for the introduction of a number of very important nursery tree selections.

Ken Cochran, curator of the OSU-OARDC Secrest Arboretum in Wooster, has already dedicated acreage for a new plot, with groundbreaking for initial plantings slated for 2007 in anticipation of the 100th anniversary of the founding of Secrest Arboretum in 2008. This plot will provide an additional research base on street tree species, complementary to the STEP and new STEP sites throughout Ohio.

Ohio State's world-renowned Shade Tree Evaluation Project at the Ohio Agricultural Research and Development Center's Wooster, Ohio, campus. Photo on the left shows the plot as it was developed in the 1970s. The photo below shows the plot in its early years.

The Master Tree Stewards Master Gardener Volunteer Specialization

The Master Tree Stewards Master Gardener Volunteer Specialization is a program being launched in 2006 to educate Master Gardener volunteers on tree identification, tree care, and tree census specialties.

Volunteers will then provide outreach in their communities and, where appropriate, work in conjunction with Next STEPers to work with communities on urban forest programs and other OSUE Tree Schools. These include a major Tree Care workshop series beginning at Secrest Arboretum in July 2006 and also a full three-month annual sequence in the Secrest Academy of Landscape Arts and Sciences (SALSA).

OSU Next STEP Community Forest Web Site

This component of the project is just underway and was influenced by a recent Next STEP study tour to New York City. Next STEPers learned about the New York City Parks' Tree Counts census in which volunteers evaluated the more than 500,000 street trees in New York City's five boroughs. New York City does a marvelous job with this program, utilizing more than 1,000 tree steward volunteers and developing a very useful database of the composition, value, and condition of the city's urban forest.

We plan on adapting this program for Ohio communities, providing a series of optional parameters for evaluation to suit community needs, and a series of other educational opportunities, both with Web-based training and database management (calculations for tree value, tree identification keys, hardscape evaluations, and data-gathering).

Next STEP faculty are seeking grants in 2005-2006 for development of this web site (Battelle Endowment for Technology and Human Affairs grants, OSU Outreach and Engagement Grants, community development grants, etc.).

There are many current and potential partners involved in Next STEP. These include the Ohio Department of Natural Resources Division of Forestry, the Ohio Nursery and Landscape Association, the Ohio Chapter of the International Society of Arboriculture, many Ohio communities and communities outside Ohio, Ohio green industry companies, and a number of Ohio State University entities.

Ohio State groups include the OSU Extension Center at Wooster, the OSUE Agricultural and Natural Resources and Community Development programs, the Ohio Agricultural Research and Development Center (OARDC) Urban Landscape Ecology Program, the Departments of Horticulture and Crop Science, Plant Pathology, and Entomology, and the School of Natural Resources. Join us in taking — the Next STEP.

”””

~ 28 ~

The Heritage Garden at the Ohio Governor's Residence

Hope R. Taft, Julie F. Stone, and James A. Chatfield

Where Can You Find...

Where can you find lakeside daisies, prickly pear cactus, compass plant, northern and southern pitcher plants, bottle gentian, blue cohosh, and big leaf magnolias all in the same place?

Where can you compare a southern magnolia with three of its northern cousins? Where can you see striped bark maple, hobble bush, paw paws, and bladdernut trees?

Where can you learn about the geologic evolution of Ohio through plants?

Where can you see examples of peonies, daffodils, or irises hybridized by Ohioans? Where can you see plants identified by Ohio greats such as Lucy Braun, William Sullivant, and John Redell or new discoveries made by Dewey Hollister and Bill Hendricks?

Where can you learn Ohio political history through trees or see the raw materials of Ohio's first industries? Where can you see the inner workings of an all-Ohio-made solar array?

Where can you educate students about a wide variety of indigenous plants, some with their exotic cousins for comparison? Where can you show clients that native plants have a place in a residential garden? Where can you learn how to create a bog, a prairie, or a sand dune in a small space or plant roses using the pot-in-pot method?

Where can you see all this — and more — in three acres and an hour?

A Special Place for Native Plants

There is one public garden in Ohio where this can be done. It is the Heritage Garden at the Ohio Governor's Residence.

Started in 2002 by First Lady Hope R. Taft and through the efforts of a wonderful cadre of landscape architects, horticulturists, botanists, nurseries, arboreta, botanical gardens, universities, master gardeners, garden clubs, state departments, and friends, the Ohio Heritage Garden has developed into a special place for native plants set in small areas that capture the essence of Ohio's five major physiographic regions.

An Award-Winning Site

The Heritage Garden master plan by Gary Meisner and Dewey Hollister and solar array by Green Energy Ohio have been recognized with awards from the American Institute of Architects.

Hope R. Taft, Ohio's First Lady and wife of Governor Bob Taft; Julie F. Stone, Manager, Ohio Governor's Residence, Bexley; and James A. Chatfield, Ohio State University Extension Center at Wooster, Horticulture and Crop Science.

Julie F. Stone (left), Hope R. Taft (center), and Bill Stalter, ONLA, at the Heritage Gardens.

The Heritage Garden is a registered Backyard Wildlife Habitat with the National Wildlife Federation and Ohio Department of Natural Resources and has seen a big increase in the number of birds and butterflies that frequent it since native plants were introduced.

Raising the Profile of Ohio-Grown Plants

A visit to the Heritage Garden encourages more gardeners to look for plants grown in Ohio and nurseries to place the Ohio Proud logo on their locally grown plant materials. Working with the Ohio Nursery and Landscape Association (ONLA) and the green industry, the Heritage Garden is raising the profile of locally grown plant materials and their importance to Ohio's economy.

The Heritage Garden is encouraging the use of plants native to the eastern United States and is heightening the importance of saving Ohio genotypes in public and private spaces through conservation and preservation.

The Heritage Garden is also encouraging Ohio's public gardens and arboreta to join forces and promote tourism. The Heritage Garden brings excitement to its nearly 10,000 yearly visitors by focusing on Ohio gardening through the cultural history of plants.

A Legacy for Future Generations

Fund raising is underway for a water garden to showcase Ohio's aquaculture and to add that environment to gardens representing the Allegheny plateau, the Appalachian hills, a Lake Erie sand dune, a cranberry bog, and prairie, meadow, and woodland plants. A web site and a state-of-the-art labeling system are in progress.

The Governor's Residence and Heritage Garden in the Bexley area of Columbus are open for tours by appointment. Call Julie F. Stone, Residence Manager, at 614-644-7644, or e-mail Governorsresidence@gov.state.oh.us.

Please contact us to find out how you can be part of this new and uniquely exciting gardening effort in Ohio. The Heritage Garden is always looking for new partners to fulfill its vision as a public botanical garden filled with educational possibilities using plants to excite its visitors about their native environments and its history.

Join our efforts to create a place to see bits of the best of Ohio and to encourage in-depth exploration of the state. Help create a legacy for future generations.

Ohio State Gets Involved

A Final Note from J. Chatfield: Ohio State University Extension's Nursery, Landscape, and Turf Team is getting involved with the Heritage Garden, participating in writing cultural histories of many of the plants and scheduling workshops in 2006 and beyond about the woody and herbaceous plants of the Heritage Garden.

In July of 2005 Hope Taft; Residence Manager Julie Stone; Bill Stalter, the Executive Director of the Ohio Nursery and Landscape Association; and Jim Chatfield strolled through the gardens at Hope Taft's invitation, especially focusing on her interest in incorporating into the garden the input of Ohio's multibillion-dollar green industry and its importance to the economy of Ohio.

From that visit the Garden now has some additions provided by OSU's Secrest Arboretum Curator Ken Cochran, including a paw paw for the native tree plantings, a Carolina silverbell, and a Chinese fringetree. Hope Taft was especially pleased by the silverbell as an earlier specimen was an inadvertent garden casualty.

Interpretive and Educational Features

The Heritage Garden is like all good gardens — a work in progress — and is growing with interpretive and educational features. There are "tree cookies" from the Ohio Department of Agriculture, slices of cut trunks and their growth rings from 114-year-old oaks, examples differing in size greatly due to different environments relative to sun and shade exposure. There is a children's garden area.

There are plaques under a healthy Japanese cherry, propagated from one of the trees which Nellie Taft, the great grandmother of Governor Taft, helped plant along the Tidal Basin in Washington, D.C., in 1912. The entire world admires those Tidal Basin cherries during Washington's annual springtime cherry blossom festival.

Tuesdays Are Tour Days

This is all part of Hope Taft's vision to make the Heritage Garden a permanent living garden jewel in Ohio's public garden crown. More than 10,000 tour the gardens (Tuesdays are tour days), and there is a growing commitment of Ohio's horticultural organizations to support the continuum of this garden into the future. Another group, the Garden Clubs of Ohio, with its more than 200 clubs statewide, all provide support to the Heritage Garden.

So next time you are out and about in Ohio, work the Heritage Garden into your horticultural tour. Ohio is truly blessed — from Spring Grove Cemetery and Arboretum in Cincinnati to Dawes Arboretum in Newark to Kingwood Center in Mansfield to Stan Hywet Hall and Gardens in Akron to Cleveland Botanic Gardens to Holden Arboretum near Kirtland to the Arboreta of Ohio State University (Secrest in Wooster and Chadwick in Columbus).

Oh, and one last word from First Lady and gardener Hope Taft, always educating and spreading the word — for example, on our July visit when explaining the difference between reeds and the triangular-stemmed sedges in her native Ohio garden: "Reeds are round and sedges have edges."

'''

 1-2006-jaf

The Ohio State University
Ohio Agricultural Research and Development Center
1680 Madison Avenue
Wooster, Ohio 44691-4096
330-263-3700

In Partnership With
Ohio State University Extension
College of Food, Agricultural, and Environmental Sciences

Ohio Agricultural Research and Development Center
In Partnership With
Ohio State University Extension
College of Food, Agricultural, and Environmental Sciences